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THE POLYPORACEAE OF COLORADO[1]

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I. INTRODUCTION

SCOPE AND AIM

The purpose of this paper is to give a detailed account of the different members of the Polyporaceae found in Colorado. This account includes all the pore fungi known to occur in the state up to the time of publication. Yet at the rate in which species new for this region have been found during the past years it is evidently not all-inclusive. The state is so large and some regions so inaccessible that an exhaustive survey of this region for pore fungi could not be completed in a lifetime by any one individual. At all events, this treatise includes all members of the family which are frequently encountered.

A consideration of the Polyporaceae has a two-fold aspect: the first is the purely taxonomic aspect of the subject with which this paper primarily deals; the second is the economic phase of the subject, which is only suggested in this study. The pore fungi are of great economic importance in the decay of both living and dead trees, structural timber, fence posts, telephone poles, railroad ties, and all other things made of wood.[2] In addition to the pore fungi, other families of fungi, such as the Hydnaceae, the Thelephoraceae, the Agaricaceae, etc., are responsible in rendering merchantable timber worthless.

[1] An investigation carried out at the Missouri Botanical Garden in the Graduate Laboratory of the Henry Shaw School of Botany of Washington University and submitted as a thesis in partial fulfillment of the requirements for the degree of doctor of philosophy in the Henry Shaw School of Botany of Washington University.

[2] Hubert, E. E. Outline of forest pathology. New York, 1931.

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Only one member of the Polyporaceae is known to enter into a mycorrhizal relation with the roots of forest trees. Masui[3] reports that *Polyporus leucomelas* forms such a relation with *Pinus densiflora*.

Although this paper deals particularly with the Colorado polypores, it is more or less adaptable to the entire Rocky Mountain range, due to the fact that the trees upon which these fungi grow and with which they are for the greater part coextensive are usually distributed throughout that region. For example, Douglas spruce (*Pseudotsuga mucronata*) reaches its best development in Colorado, but extends far north and south. Lodgepole pine (*Pinus Murrayana*) is found throughout the Rocky Mountains and even in Alaska, as well as in California. In the use of this treatise in states other than Colorado, it is to be remembered that timberline in Colorado is about 11,500 feet; whereas in more northern regions it occurs at a lower elevation (9,000 feet in Montana; 7,000 feet in Alberta), and is higher southwards. On the western slope in the Rocky Mountains, any particular tree-species is 1,000 feet lower in elevation than the same species on the eastern slope.

HISTORY

Up to the present time, nearly all the information on Colorado fungi has been gathered by out-of-state collectors who have visited Colorado for one or more summers, as: J. C. Arthur, F. D. Kern, Fred J. Seaver, L. O. Overholts, C. H. Kauffman, E. Bartholomew, C. L. Shear, and others. Within the state there has been only one noteworthy collector of fungi who was more interested in the rusts on conifers than in any other branch of mycological work. He was the late Ellsworth Bethel, who collected in Colorado from 1894 to 1925, which latter date marked his untimely death. Mention should be made also of the work of W. C. Sturgis on the slime molds. A more detailed account of the history of mycological collectors in Colorado may be found elsewhere.[4]

[3] Masui, K. A study of the ectotrophic mycorrhizas of woody plants. Kyoto Imp. Univ. Mem. Coll. Sci. 3B: 179. 1927.

[4] Shope, P. F. History of mycological collectors in Colorado. Mycologia 21: 292–296. 1929.

II. Distribution

General Consideration

Since pore fungi are for the greater part either parasitic or saprophytic on wood, the general opinion has prevailed that their distribution is primarily coextensive with that of their hosts. Ramsbottom[5] states: "No attempt to understand the ecology of the larger fungi can be successful unless they are considered in their relation to higher plants, for, in addition to edaphic factors, light, heat, moisture and movement of the atmosphere play a a part." Rea[6] has somewhat the same idea; he states: "The problem of the distribution of the British macrofungi is based on their association with other plants. This association is either saprophytic, parasitic, or symbiotic, but the majority of the macrofungi belong to the first group. Other factors governing the distribution of the larger fungi are the geological formation and nature of the soil on which they grow, the humidity or dryness of the atmosphere or habitat, the height above sea level, the density of growth and the presence or absence of strong light especially in woods."

Before entering into the discussion of the distribution of the pore fungi of Colorado, it would be well to consider the zones of vegetation for the higher plants of this region. Ramaley's[7,8] divisions of the plant zones for the Rocky Mountains of Colorado will be used in this paper. A synopsis of the general characteristics, as well as a list of the higher plants and fungi which occur in these zones, will follow. The altitude for each of these zones is given in relation to vegetation on eastern slopes in central Colorado. Changes should be made in elevations for regions north and south as well as for western slopes.

1. Plains zone: up to 6,000 feet. Mean annual temperature 49.8° F. Annual precipitation 14.2 inches; 5 feet of snow.[9] Meso-

[5] Ramsbottom, J. in Tansley, A. G. & T. F. Chipp. Aims and methods in the study of vegetation. p. 162. London, 1926.

[6] Rea, C. The distribution of the dominant British macrofungi. Paper presented before the International Congress of Plant Sciences. Ithaca, N. Y. 1926. Quotation from author's abstract.

[7] Ramaley, F. R. Plant zones in the Rocky Mountains of Colorado. Science, N. S. 26: 642–643. 1907.

[8] ———, Colorado plant life. pp. 3–6. Boulder, 1927.

[9] ———, & G. S. Dodds, The University of Colorado Mountain laboratory at Tolland, Colorado. Univ. Colo. Studies 12: 8. 1917.

phytic in the spring due to the accumulation of moisture in the soil from the winter's melting snow and also the spring rains. After the spring rains this region is for the greater part arid. In general, the vegetation of the region is that of dry grassland with an abundance of spring-blooming herbs. Cottonwoods (*Populus* spp.) and willows (*Salix* spp.) are found bordering the streams; a few pines (*Pinus* spp.) and junipers (*Juniperus* spp.) occupy exposed sandy bluffs. Sagebrush (*Artemisia* spp.) and rabbitbrush (*Chrysothamnus* spp.) are sometimes intermixed with the grasses. The soil is fine-grained alluvium, sometimes covered with wind-blown deposits.

Polyporus versicolor, *P. adustus*, and *Trametes hispida* are found abundantly on willows (*Salix* spp.) and cottonwoods (*Populus* spp.). In the spring and during the short moist season many gill fungi abound. Puffballs are found in the grasslands, but all disappear on the advent of dry soil conditions in late spring. Many rusts occur on different members of the *Poaceae* and on various species of *Artemisia*. These rusts persist throughout the summer and autumn.

2. Foothill zone: 6,000 to 8,000 feet. This zone is slightly better watered than the plains zone. Summer showers occur frequently in the hills but seldom reach the plains; and in winter many a light snowfall in the mountain does not extend down below the foothills. In this zone, the snow that falls during the winter is entirely melted by the early part of May. The characteristic vegetation is open forests of rock pine (*Pinus scopulorum*) with an intermixing of Douglas spruce (*Pseudotsuga mucronata*) and junipers (*Juniperus* spp.). Pinyon pine (*Pinus edulis*) occurs south of Colorado Springs and in scattered areas north of Fort Collins, Colorado. Chaparral of oak (*Quercus* spp.), mountain mahogany (*Cercocarpus* spp.), and other shrubby xerophytic plants is found, especially in the southern part of the state. Cottonwoods (*Populus* spp.) and willows (*Salix* spp.) of various kinds, aspen (*Populus tremuloides*), maple (*Acer glabra*), birch (*Betula* spp.), mountain ash (*Sorbus scopulina*), thorn-apple (*Crataegus* spp.), sumac (*Rhus cismontana*), and others represent the woody deciduous vegetation. The soil is somewhat more gravelly than that of the plains.

Polyporus versicolor, *P. adustus*, and *Trametes hispida* occur on willows (*Salix* spp.), cottonwoods (*Populus* spp.), and aspen (*Populus tremuloides*). Rock pine (*Pinus scopulorum*) and Douglas spruce (*Pseudotsuga mucronata*) harbor *Trametes odorata* (*T. protracta* in the American sense), *Polyporus abietinus*, *Lenzites saepiaria*, *Trametes subrosea*, *Fomes Pini*, and *F. pinicola*. *Polyporus volvatus* has been found a few times on rock pine (*Pinus scopulorum*) in this region.

3. Montane zone: 8,000 to 10,000 feet. Mean annual temperature 41.0° F. Annual precipitation 24.16 inches; 15 feet of snow. In this zone and above the rainfall and snowfall are considerable. During the summer months showers of short duration occur almost daily; at times there are long-continued rains. The snowfall is heavier than in the foothill zone, and snowdrifts, sheltered under the trees, persist until June or July. Due to a late spring and an early autumn in this region, the growing season is from three to three and one-half months. Here are coniferous forests of lodgepole pine (*Pinus Murrayana*), or lodgepole pine mixed with Engelmann spruce (*Picea Engelmanni*), Douglas spruce (*Pseudotsuga mucronata*), and rock pine (*Pinus scopulorum*). This zone represents the uppermost limit for Douglas spruce (*Pseudotsuga mucronata*), rock pine (*Pinus scopulorum*), pinyon pine (*Pinus edulis*), concolor fir (*Abies concolor*), and all the junipers (*Juniperus* spp.) with the possible exception of *Juniperus sibirica*, which sometimes extends up into the subalpine zone. The Colorado blue spruce (*Picea pungens*), with a range of 7,000 to 9,000 feet on the eastern slope, and a range of 6,000 to 8,000 feet on the western slope, reaches its best development in the lower altitudes of this zone and in the upper foothill zone. It is found only in moist locations and usually bordering on streams. Aspens (*Populus tremuloides*) are best developed and form dense groves in this zone, but their altitudinal distribution is greater than that of any other tree in Colorado. Aspens may be found in the foothills and extending up through the different zones almost to timberline. Mountain parks represent a conspicuous part of the landscape in this zone and extend up into the lower limits of the subalpine zone. Different species of cottonwoods (*Populus* spp.) and willows (*Salix* spp.), alder (*Alnus tenuifolia*),

elder (*Sambucus* spp.), birch (*Betula* spp.), mountain maple (*Acer glabrum*), hazelnut (*Corylus rostrata*), choke cherry (*Prunus melanocarpa*), and wild cherry (*Prunus americana*) represent the woody deciduous plants in this zone.

The montane and subalpine zones furnish the best collecting grounds in the state. The common pore fungi found mainly on coniferous hosts are: *Fomes Pini, F. pinicola, Polyporus alboluteus, P. leucospongia, P. abietinus, P. ursinus, Trametes variiformis, T. isabellina, T. odorata,* and *Lenzites saepiaria.* Those found on deciduous hosts are: *Fomes igniarius* and *Polyporus adustus.* Many gill fungi abound in the well-wooded areas. Rusts are found on grasses and conifers. There are many thelephoraceous species, of which *Stereum rugisporum* is very common. *Auricularia Auricula-Judae* (Jew's ear fungus), *Dacryomyces abietinus, Exidia glandulosa, Guepinia monticola* and other jelly-like species are of frequent occurrence here as well as in the subalpine zone. Cup fungi are well represented; *Dasyscypha Agassizii* and *D. arida* are both common.

4. Subalpine zone: 10,000 to 11,500 feet. The mean annual temperature in this zone is a few degrees cooler than that of the montane zone; also, there is slightly more rain in the summer and more snow during the winter than in the lower adjacent zones. Snowdrifts often remain in the closed stands of Engelmann spruce (*Picea Engelmanni*) until August. Again, the snow which has accumulated during the winter may not entirely disappear during the few warm months of the summer. The growing season is from two and one-half to three and one-half months. The upper limit of this zone is characterized by dwarfed timberline trees of Engelmann spruce (*Picea Engelmanni*), sometimes mixed with bristle-cone pine (*Pinus aristata*), lodgepole pine (*Pinus Murrayana*), and subalpine fir (*Abies lasiocarpa*). The floor of the Engelmann spruce forest is usually covered with a mat of blueberry plants (*Vaccinium* spp.). The woody deciduous plants of common occurrence are dwarf willow (*Salix* spp.) and aspen (*Populus tremuloides*).

Nearly all the fungi found on conifers in the montane zone extend up into the lower limits of this zone. Deciduous trees and shrubs are sparse in this region. *Polyporus leucospongia, P. albo-*

luteus, and *Lenzites saepiaria* are the dominant pore fungi near timberline. *Vaccinium oreophilum* is often badly infected with the rust fungus *Calyptospora columnaris*. Rusts on coniferous trees, gill fungi, and cup fungi are frequently found. *Paxina nigrella*, growing a short distance from the edge of snowdrifts, is of interest because of its habitat.

5. Alpine zone: above 11,500 feet, or above timberline. Mean annual temperature 26.0° F. Annual precipitation 43.69 inches, most of which falls in the form of snow. The growing season is very short, only two to two and one-half months. No trees are present, but low thickets of dwarf willow (*Salix* spp.) are found in protected places. Above timberline, there are grassland steppe or tundra and rock desert, and in all of these formations the soil is coarse and gravelly. Many herbaceous plants are mat- or cushion-like and all assume a low or prostrate growth-form. Rather limited areas of grasses and sedges exist.

Due to the absence of trees and to the dryness of the soil, this region contains very few fungi and no polypores. A few gill fungi, some cup fungi, and rust fungi represent the sparse mycological flora.

These plant zones intergrade one into the other. There is no abrupt change in vegetation as one passes from the altitudinal boundary of one zone into the next. However, the plants observed at the altitudinal middle-distance of one zone will be found to be markedly different from those observed from a similar position in an adjacent zone. The characteristic vegetation of any zone is not drawn from the plants found near the altitudinal limits of that zone, but from the plants found in its altitudinal middle-distance.

The differences in plant life, as one proceeds from a lower to a higher elevation, are correlated primarily with differences in climate. Contrasting the alpine zone with lower zones, the following climatic and edaphic factors may be listed for the higher zone, as follows:

Colder air temperature.
More rare atmosphere.
Brighter sun.
Shorter growing season.

Higher winds.
Coarser soil.
Colder soil.
Lower relative humidity.
Dryer soil due to rapid evaporation; or else physiologically dry soil due to frost or low soil temperature.
More precipitation, most of which falls in the form of snow.
Possible difference in the soil reaction, in chemical constituents, and in the micro-flora and -fauna of the soil.

In the consideration of the distribution of the fungous flora of these different zones, only the more common species have been listed in the zones where they seem to be most abundant. An overlapping of species occurs in adjacent zones, but, as with certain trees which are dominant in a particular zone, some fungi belong primarily and are of more common occurrence in a certain zone.

Summarizing the preceding data on the zonal distribution of pore fungi, the more sparse flora occurs in the plains zone, the lower limits of the foothill zone, the upper limits of the subalpine zone, *i. e.*, timberline and the alpine zone. In other words, the two altitudinal extremes contain few fungi, whereas the regions between these limits contain many more. Many species are confined to a single zone or to two adjacent zones, others are widespread in their distribution. It is clear from the foregoing paragraphs that there is a distinct correlation between the abundance of woody plants in a region and the occurrence of pore fungi.

Since both common and scientific names[10] are used for the host plants in this treatise, a list of the more common trees with their synonyms and altitudinal range will follow. The first scientific name is the accepted one; those following are synonyms. Where two or more common names are given, the first one is generally used throughout this work.

Coniferous plants:

Abies concolor Lindl. & Gord. Concolor Fir, White Fir. 8,000–10,000 feet.

[10] The classification used for the phanerogams is based primarily on Coulter, J. M. & A. Nelson's 'New manual of Rocky Mountain botany.' New York, 1909.

Abies lasiocarpa (Hook.) Nutt. (*Pinus lasiocarpa* Hook.; *Abies subalpina* Engelm.). Subalpine Fir, Alpine Fir, Balsam. 8,000–11,500 feet.

Juniperus communis L. Low Juniper. 5,000–8,000 feet.

Juniperus monosperma (Engelm.) Sarg. (*Sabina monosperma* (Engelm.) Rydb.; *Juniperus occidentalis monosperma* Engelm.). One-seeded Juniper. 5,000–7,000 feet.

Juniperus scopulorum Sarg. (*Sabina scopulorum* (Sarg.) Rydb.). Red Cedar, Rocky Mountain Red Cedar. 4,500–8,500 feet.

Juniperus sibirica Burgsd. Mountain Juniper, Low Juniper. 6,000–10,000 feet.

Juniperus utahensis (Engelm.) Lemm. (*Sabina utahensis* (Engelm.) Rydb.). Utah Juniper, Desert Juniper. 6,000–9,000 feet.

Picea Engelmanni or *P. Engelmannii* (Parry) Engelm. (*Abies Engelmanni* Parry; *Picea columbiana* Lemm.). Engelmann Spruce. 8,500–11,500 feet.

Picea pungens Engelm. (*Picea Parryana* (Andre) Sarg.; *Abies Menziesii Parryana* Andre). Colorado Blue Spruce. 6,500–10,500 feet.

Pinus aristata Engelm. Bristle-cone Pine, Foxtail Pine. 8,500–11,500 feet.

Pinus edulis Engelm. (*Caryopitys edulis* (Engelm.) Small). Pinyon Pine. 4,000–9,000 feet.

Pinus flexilis James (*Apinus flexilis* (James) Rydb.). Limber pine. 7,500–11,000 feet.

Pinus Murrayana Balf. (*Pinus contorta* Loudon). Lodgepole Pine. 6,500–10,500 feet.

Pinus scopulorum (Engelm.) Lemm. (*Pinus ponderosa scopulorum* Engelm.). Rock Pine, Yellow Pine. 5,000–9,000 feet.

Pseudotsuga mucronata (Raf.) Sudw. (*Pseudotsuga taxifolia* (Lamb.) Britt.; *P. Douglasii* (Lindl.) Carr.; *Abies mucronata* Raf.; *Pinus taxifolia* Lamb.). Douglas Spruce, Douglas Fir. 6,000–10,000 feet.

Deciduous plants:

Acer glabrum Torr. (*Acer neomexicanum* Greene). Rocky Mountain Maple. 5,000–9,000 feet.

Acer Negundo L. (*Negundo aceroides* Moench; *Negundo Negundo* (L.) Karst.; *Rulac Negundo* Rydb.; *Rulac texanum* Rydb.). Box Elder. 5,000–6,500 feet.

Alnus tenuifolia Nutt. (*Alnus incana virescens* S. Wats.). Alder. 5,000–10,000 feet.

Betula fontinalis Sarg. (*Betula occidentalis* Nutt.). Canyon Birch, Fountain Birch, Rocky Mountain Bog Birch. 5,000–9,000 feet.

Betula glandulosa Michx. Scrub Birch, Swamp Birch. 8,500–11,000 feet.

Corylus rostrata Ait. Hazel-nut. 5,500–8,000 feet.

Crataegus spp. Thorn-apple, Hawthorn. Probably five species, with a range of 5,500–7,000 feet.

Populus angustifolia James. Narrow-leaf Cottonwood. 5,000–9,000 feet.

Populus occidentalis (Rydb.) Britt. (*Populus deltoides occidentalis* Rydb.; *P. angulata* Port. & Coult.; *P. Sargentii* Dode). Cottonwood, Western Cottonwood. 5,000–9,000 feet.

Populus tremuloides Michx. Aspen, Trembling Aspen, Quaking Aspen. 5,800–10,000 feet or more.

Prunus americana Marsh. Wild Plum. 5,000–8,000 feet.

Prunus melanocarpa (A. Nels.) Rydb. (*Prunus demissa* Torr. in part; *Cerasus demissa melanocarpa* A. Nels.). Choke Cherry. 5,000–9,000 feet.

Prunus pennsylvanica L. f. Wild Cherry. 6,000–9,000 feet.

Rhus cismontana Greene (*Rhus glabra* L.; *R. nitens, R. tessellata, R. albida,* and *R. asplenifolia* Greene). Sumac. 5,500–7,500 feet.

Salix spp. Willow. Probably twenty-eight species, with a range of 5,500–14,000 feet.

Shepherdia argentea Nutt. (*Lepargyaea argentea* (Nutt.) Greene). Buffalo Berry, Bull-berry. 5,000–6,000 feet.

Sorbus scopulina Greene. Mountain Ash. 6,000–10,000 feet.

Ulmus americana L. American Elm, White Elm. Introduced. 5,000–5,500 feet.

FACTORS DETERMIN NG THE D STRIBUTION OF THE POLYPORACEAE

The geographic and climatic factors which are responsible for the distribution of fungi in this region are listed as follows:

Topography of the country.

Temperature and its influence upon spore germination and growth.

Physical and chemical nature of the substratum.

Moisture and its influence upon spore germination and growth.

Topography of the country.—Northern slopes when compared with southern ones of a similar elevation are more moist throughout the spring and early summer due to the slower melting of the winter's accumulated snow; thus they support a richer flora of both fungi and higher plants. Likewise, western slopes when compared with eastern ones are favored with better moisture conditions. Areas protected from prevailing winds are more moist and harbor a richer fungous flora than exposed slopes. Regions bordering on streams and lakes are usually well watered.

Specimens of pore fungi under alpine conditions usually differ from the same species found at lower levels by their smaller size and their tendency towards resupinate growth. This is well shown in *Polyporus abietinus* and *Fomes Pini*, which are most often found to be resupinate at their highest points of distribution. In dry locations and also in high altitudes, sporophores are usually found closer to the ground than in more moist or lower situations.

Temperature and its influence upon spore germination and growth.—Snell[11] shows that there is an optimum temperature for spore germination which is different for different species. Furthermore, he shows that these temperatures may not be the same as the optimum temperature for the best mycelial growth of the species. If new infections originate from germinating spores, this may result in the limitation of a species to a zone where a favorable temperature for spore germination prevails during that period. However, indications point to the fact that the inocula for many primary infections come from the soil. Snell[12] reports that the spores of *Lenzites saepiaria* germinate at temperatures ranging from 12° C. to 40° C., and those of *Trametes serialis* from 3° C. to 40° C. He shows that at these temperature extremes, the spores require a relatively long time for germination, in some cases as long as two days. Furthermore, he points out that in

[11] Snell, W. H. Studies of certain fungi of economic importance in the decay of building timber. U. S. Dept. Agr., Bull. 1053. 1922.

[12] ————, *l. c.* p. 8.

most of the species with which he worked, the greater percentage of spore germination and the most rapid growth take place at temperatures from 28° to 32° C.

Although temperatures from 28° to 32° C. are rarely reached in the plains and foothills zones, and probably never at higher elevations, there are days throughout the growing period when relatively favorable temperatures for spore germination do exist; but during the night, at high elevations, the temperature may fall to near 0° C. Since, as pointed out by Snell (*l. c.*), it takes from twenty hours to several days for spores of the pore fungi to germinate *in vitro*, even under the most favorable conditions of moisture and temperature, favorable conditions during the daytime apparently do not represent a sufficient length of time for germination. The actual effect of the cold nights upon spore germination of the pore fungi is unknown to the writer, but it is thought that the cold nights only retard germination and growth of the germ-tube. Thus the germination period is lengthened as a result of the alternate favorable and unfavorable conditions of temperature. Moreover, even though there is a pronounced change in the day and night air temperatures, during the night the temperature of the substrata and soil does not change as rapidly nor to the same extent as that of the air. Hence spores which are deposited upon a substratum may not be subjected to the same nightly drop in temperature as that of the air. Barring the possibility that all primary infections at higher elevations come from inocula in the soil which originally attained these higher elevations by the slow process of vegetative migration from lower levels where conditions for spore germination were more favorable, or else conveyed by animals or birds, the presence of the pore fungi under these conditions would indicate that spore germination actually takes place, resulting in infection.

The arctic conditions of the higher regions during the winter months evidently do not kill pore fungi. Buller and Cameron[13] have demonstrated that the fruiting bodies of several pore fungi can withstand temperatures of −100° C. or lower. Certainly no such extreme in temperature exists in the Rocky Mountains.

[13] Buller, A. H. R. & A. T. Cameron. On the temporary suspension of vitality in the fruit bodies of certain Hymenomycetes. Trans. Roy. Soc. Can. III. 6: sect. 4, 73–75. 1912.

Miss Stevens[14] has pointed out that: ". . . at night or in the shade the temperature of twigs and small branches approximate that of the air, whereas in the sunlight their temperature is generally above, sometimes as much as 20° C. above that of the air." This datum is of importance in the growth of fungi which are already established, but as far as spore germination is concerned the direct rays of the sun probably do more damage in drying out the substratum than they do good in giving heat to the germinating spores. In this connection, the possible harmful effects of ultra-violet at high elevations should not be overlooked.

Since the wealth of our fungous flora is primarily limited to the heavily forested regions where the sun's rays seldom penetrate to the forest floor, heat from the direct rays of the sun plays a minor role. It has been noted,[15] however, that pore fungi are of a darker color at high elevations, thus possessing a greater ability to absorb heat. A departure from this is *Polyporus leucospongia* which is frequently found growing in exposed places. This fungus is of a whitish color which may be instrumental in reducing the quantity of heat absorbed from the sun's intense rays at high elevations, thus lowering the rate of evaporation.

Physical and chemical nature of the substratum.—Weir[16] states that: "Any factor that influences the cellular and chemical development of the wood of a tree may influence the growth of some wood-destroying fungi, hence their distribution. Aside from the moisture relation which is always a factor in promoting the growth of fungi, the influence of elevation on the chemical and anatomical structure of forest trees is a well known phenomenon and in a measure determines their predisposition to disease."

The writer[17] has elsewhere pointed out the anatomical changes in aspen at different elevations in Colorado. Trees growing at high elevations have narrower annual increments of growth, and in many cases, harder wood than the same species found at lower

[14] Stevens, N. E. Environmental temperatures of fungi in nature. Am. Jour. Bot. 9: 286. 1922.

[15] Weir, J. R. Notes on the altitudinal range of forest fungi. Mycologia 10: 4–14. 1918.

[16] ———, *l. c.* p. 8.

[17] Shope, P. F. Stem and leaf structure of aspen at different altitudes in Colorado. Am. Jour. Bot. 14: 116–119. 1927.

levels. This, according to Zeller,[18] makes the high altitude trees more resistant to decay through the reduction of the volume of air content of the wood. Other anatomical features, such as size of cells, thickness of cork, and proportions of spring and summer wood, probably play a more or less important role in the predisposition of the host to disease. The quantity and distribution of resin, tannin, gums, and lignin are factors for additional consideration.

As to the soil as a substratum for pore fungi, there is a change in the quantity, quality, and physical and chemical make-up of soils at different elevations. Very little data are at hand on this phase of the subject; however, few pore fungi in this region are ground-inhabiting.

Moisture and its influence upon spore germination and growth.— With reference to spore germination, temperature relations have already been considered under the second heading; moisture relations, however, have yet to be considered. Zeller[19] has shown that the best rate of germination of spores of *Lenzites saepiaria* on wood takes place when the moisture of the substratum is at or in excess of the fiber saturation point, and at a lower moisture content the rate and percentage of germination are relatively lower. A condition of moisture adequate to produce the fiber saturation point of the substrata would exist at timberline only during the spring of the year when the snow is melting. In the lower subalpine and in the upper montane zones, such conditions would exist well into the summer and in some years during the entire growing season. In the foothill and plains zones, these conditions of moisture would exist only during the spring and early summer, or during unusually wet summers. Indications would point to the fact that infection from the germination of spores takes place mainly during these periods of suitable moisture conditions.

If conditions for spore germination are favorable during certain parts of the year at all elevations, it may be assumed that during these same seasons of the year, conditions would be favorable for

[18] Zeller, S. M. Physical properties of wood in relation to decay induced by *Lenzites saepiaria*. Ann. Mo. Bot. Gard. 4: 93–164. 1917.

[19] ———, Humidity in relation to moisture imbibition by wood and to spore germination on wood. Ann. Mo. Bot. Gard. 7: 68–74. 1920.

mycelial growth and sporophore production. However, the accumulated snow, in most cases, has disappeared by July or August and the soil and substrata slowly dry out to be watered throughout the remainder of the season only by occasional showers of short duration. The question is, how do these fungi persist through the summer or dry season?

The great amount of precipitation in the subalpine and montane zones would indicate a luxuriant growth of all kinds of vegetation. As previously mentioned, fungi are most abundant in these zones, but these same zones may become quite arid during the months of July, August, and September, especially as timberline is approached. The dryness of the timberline region is not due to lack of precipitation, but to drainage and the exceedingly rapid rate of evaporation induced by high winds and low humidity. The plains are likewise arid during the summer months, because rainfall is very much less than at higher elevations and a great part of the precipitation falls during the non-growing seasons of the year. The problem, then, is to account for the presence of pore fungi at timberline and in the lower foothill and plains zones. The pore fungi at timberline will be considered first.

TABLE I

PERCENTAGE OF WATER ABSORPTION, BASED ON PERCENTAGE AIR-DRY WEIGHT

	Intervals in minutes					
	10	20	30	40	50	60
Polyporus versicolor	192.8	215.4	226.2	233.3	238.1	238.1
Trametes hispida	210.3	227.8	244.3	258.7	263.9	271.0
Polyporus adustus	315.2	325.0	328.1	329.3	331.2	335.0
Trametes odorata	177.8	181.1	188.2	190.5	196.0	197.5
Trametes subrosea	180.3	195.0	195.0	195.0	195.9	195.9
Fomes Pini	55.3	73.7	87.7	99.5	109.0	118.4#
Fomes pinicola	59.4	93.9	108.4	113.9	116.3	116.6#
Lenzites saepiaria	250.4	264.7	271.7	274.6	277.5	284.1
Polyporus leucospongia	483.6	523.6	603.5	619.3	636.7	650.0
Polyporus ursinus	130.9	165.7	183.0	194.1	205.5	207.6
Polyporus alboluteus	465.5	540.8	556.3	583.5	587.3	589.8

All specimens were saturated at the end of one hour's soaking, except those marked "#."

TABLE II

PERCENTAGE OF WATER LOSS THROUGH EVAPORATION, BASED ON PERCENTAGE SATURATED WEIGHT

	Intervals in hours															
	4	6	10	16	20	24	28	41	46	50	65	91	103	150	180	220
Polyporus versicolor	52.8	70.7	90.0	100												
Trametes hispida.....	25.2	37.1	65.2	75.0	84.9	91.5	97.5	100(32								
Polyporus adustus.....	24.8	36.2	70.5	88.5	91.6	97.0	100	hrs.)								
Trametes odorata.....	20.1	29.2	57.5	68.0	78.6	86.2	93.6	99.5	100							
Trametes subrosea.....	10.9	24.3	54.5	66.8	75.6	82.6	90.0	98.8	100							
Fomes Pini.....	8.2	14.6	16.2	30.0	38.8	50.5	55.3	62.8	68.8	73.5	80.0	88.6	92.5	99.0	100	
Fomes pinicola.....	6.7	11.8	12.7	25.4	32.4	37.6	43.0	55.6	60.4	63.6	71.6	80.5	86.6	94.6	98.1	100
Lenzites saepiaria.....	21.5	33.4	43.0	70.0	82.1	91.2	96.0	100								
Polyporus leucospongia	11.2	20.7	39.0	72.0	83.3	90.0	96.0	100								
Polyporus ursinus.....	12.4	18.5	23.6	46.2	53.4	60.2	66.4	79.3	83.2	85.8	93.0	99.0	100			
Polyporus alboluteus....	18.7	20.9	27.2	50.8	60.0	72.3	80.7	97.9	100							

The experiments, the results of which are shown in tables I and II, were conducted at Boulder, Colorado, during the winter and spring of 1928–29. The actual laboratory work with the eleven plants listed was carried on in as rapid a succession as physically possible, so that conditions of relative humidity, room temperature, and air movements would affect all eleven plants equally.

The fungus specimens used in the following experiments were collected during the summer previous to the experiments, air-dried, and then packed away in paper sacks. The number of specimens used in each of the experiments varied according to their size; of some species, as many as twenty fruiting bodies were employed, whereas of others, fewer or only one. The specimen, or specimens, for each of the eleven species was first weighed dry; then, one at a time, they were immersed in tap-water for a period of ten minutes, removed from the water and weighed again, immersed for another ten minutes, and so on until they had been immersed for one hour.

After the experiments on the absorption of water were completed, these same specimens were used to ascertain the rate of water loss by evaporation. They were weighed at intervals as shown in the table, and the percentage of loss in weight was calculated.

The data in these tables were obtained from five separate experiments conducted at different times and with different specimens. In repeating the work five times and using different specimens, very little variation was shown. In no case was the variation in excess of 2 per cent.

The rate of water absorption, the percentage of water held, as well as the rate of water loss by evaporation, is by no means the sole solution for the altitudinal distribution of macrofungi in the Rocky Mountains, but it seems that the water relations play an important role, especially in the case of respiration.[20] Distribution cannot be based upon any one single factor, for undoubtedly several factors are involved. The water used by a fungus for its physiological functions is obtained from the substratum by

[20] Richards, F. J. The relation between respiration and water content in higher fungi. New Phytol. 26: 187–201. 1927.

absorption and conduction,[21] by the absorption of rain water which falls upon the surfaces of the sporophores, and from the moisture in the air. At high elevations, a sporophore which can absorb quickly a large quantity of water is unquestionably at a greater advantage than one in which the reverse conditions exist, for at this elevation showers are usually of short duration during the summer.

All of the pore fungi growing near timberline are wood-inhabiting. They may be found upon corticated and decorticated logs, very rarely upon living trees. If the logs still retain their bark, rain water can percolate through the cracks in the bark and keep the wood moderately moist. The bark, however, soon falls off, thus exposing the wood. The outer crust of this exposed wood becomes hard, cracked, and dry; the inner core dries out less rapidly and affords better moisture conditions for fungous growth. Thus, one frequently finds logs in which the center is entirely rotted out, whereas the outer crust is made up of apparently sound wood. If some logs have growing from them several sporophores of *Polyporus leucospongia* or *P. alboluteus*, which can absorb a large quantity of water based on their air-dry weights during a shower of one hour's duration, then these saturated sporophores can give water to their substrata in a manner similar to that in which a saturated sponge can give water to a piece of filter paper. These sporophores probably hold this great quantity of water intercellularly by capillary attraction, and by the forces set up by the colloidal nature of the outside of the walls of the hyphae. The supply of water taken into the cells by the force of suction pressure evidently does not enter into this problem in this respect, for it can scarcely be conceived that a substratum could take water from the living protoplasm of fungous hyphae which apparently have a relatively high suction pressure. Since the writer on several occasions has observed that after a rain of short duration the sporophores apparently do convey some water to the substratum, it is thought that the water is conveyed from the saturated sporophores to the substratum by the force of capillarity. Additional forces which may be involved are the outside atmos-

[21] Pieschel, E. Ueber die Transpiration und Wasservorsorgung der Hymenomyceten. Bot. Archiv 8: 64–104. 1924.

pheric pressure and the weight of the water column in the saturated sporophore.

The fungi growing at timberline are exposed to the drying effects of high winds, bright sun, and low relative humidity. They begin their growth in the spring and early summer, during which time they are watered from melting snow. Later in the summer, and when the snow has disappeared, the fungi receive their supply of water from daily showers of short duration; but during the remainder of the day they are exposed to conditions which bring about partial desiccation. It is obvious that the sporophores obtain some water from the substratum, but this supply gradually diminishes as the season advances, for it is evident that the logs, which are subjected to the same desiccating influences as the sporophores, would likewise dry out to some extent, and that the amount of water absorbed by them during the showers of short duration would not be sufficient to offset the loss by evaporation during the sunny hours of the day.

In all species that demonstrate the ability to absorb water quickly and in large quantities, as *Polyporus alboluteus* and *P. leucospongia*, the cell walls of the context are always very thick; also, the surface of the sporophore is roughly clothed or else spongy and absorbent.

From the graph (fig. 1) it can be seen that *Polyporus alboluteus* and *P. leucospongia* are outstanding in their ability to absorb a large quantity of water quickly. Furthermore, the graph shows that these two species have an additional advantage in the slowness with which they dry out, especially as they approach complete desiccation. These two species, as has been noted previously, are found chiefly in the montane and subalpine zones between 9,500 and 11,500 feet elevation.

In the case of *Lenzites saepiaria*, which is distributed from the foothill region to timberline between 6,000 and 11,500 feet elevation, the graph shows that while this fungus absorbs water less rapidly than the two preceding species, it nevertheless approaches its maximum water-holding capacity more quickly and is able to retain the water to the same extent as the species mentioned above. Thus the three species of fungi found at timberline absorb water at different rates, but appear to have in common the

ability to hold water somewhat tenaciously as they approach desiccation.

So far, the three species that grow at a high elevation have been discussed. By way of contrast, the graphs of these three species should be compared with those of *Polyporus versicolor*, *P. adustus*, and *Trametes hispida*, which are found only in the lower elevations

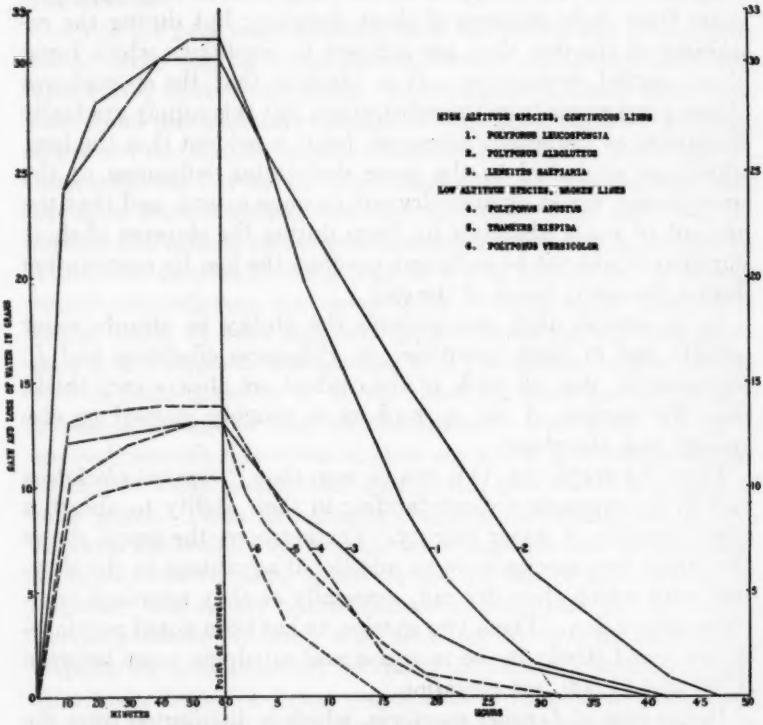

Fig. 1. Graph based on 5 grams air-dry weight of fungous material.

and never extend up to timberline, that is between elevations of 5,000 and 8,000 feet. They are of common occurrence in the plains where they grow on cottonwoods (*Populus* spp.) and willows (*Salix* spp.). In Colorado, they make their growth mainly in the spring when the logs and stumps to which they are attached are still moist from the winter's melting snow and from the spring

rains. They begin their growth surprisingly early in the season; in fact the writer has observed growth to take place as early as February and the sporophores to be fully developed by the early part of May. Furthermore, growth in midsummer takes place only during exceptionally wet summers. In the plains and foothill zones, daily showers are rare during the summer, whereas near timberline they are of common occurrence and to be expected.

On examination of the graph of these three low-altitude species, it is seen that they absorb water at approximately the same rate and to the same extent, and reach their point of saturation almost as quickly, as does *Lenzites saepiaria*. On the other hand, they appear to dry out more quickly and their retention of water as the point of complete desiccation is approached does not appear to be as pronounced as in the high-altitude species. Yet, in proportion to the amount of water absorbed, the low-altitude species appear to retain their moisture more tenaciously.

After the discussion of the water relations of pore fungi found at the two altitudinal extremes, additional light may be thrown on the problem by discussing various species found between these two altitudinal extremes.

In the *Fomes*-forms, especially *Fomes Pini* and *F. pinicola*, factors other than those mentioned for *Polyporus alboluteus* and *P. leucospongia* are involved. These two *Fomes*, which are found throughout the mountainous regions wherever suitable host-plants occur, can absorb a maximum of only 150 to 190 per cent water based on their air-dry weights. Because of their dense structure and their great size, desiccation of their sporophores takes place slowly. In dry regions, such as the foothill zone and the upper limits of the subalpine zone, these species are found to grow close to the ground. In such a position, they have the advantage of shade, high relative humidity, and in some cases, water absorption directly from the forest litter. In the more moist and more humid Engelmann spruce (*Picea Engelmanni*) belt, these species may be found growing from eight to ten feet above the ground.

Fomes Pini and *F. pinicola* are somewhat widespread in distribution, and observations show that the former species extends slightly farther into the dry regions than the latter. The sporo-

phore of *Fomes pinicola*, when growing on conifers, becomes covered with a resin-like secretion which renders the upper surface of the fructification more or less impervious to water and checks evaporation (pl. 33). No such condition exists in *Fomes Pini*. The hymenia of these species show a rate of water absorption opposite to that shown for the sporophores. To illustrate this, one square inch of the hymenium was cut out from large sporophores of the two species and all but the pore-mouths was covered with warm paraffin. After one minute's immersion in water, *Fomes pinicola* absorbed 2.5 grams of water, whereas the other species absorbed only 1.4 grams, or a little more than one-half the quantity of the former species. Prolonged soaking showed this difference to persist, but the difference became less marked. The water absorbed on prolonged soaking, however, is of less consequence than that absorbed during the first minute. The fact that the hymenium of *Fomes pinicola* absorbed water very much faster than the hymenium of *Fomes Pini* would indicate that the former species could likewise absorb more moisture from the atmosphere than the latter. The importance of the hymenium in gathering water from a humid atmosphere should not be overlooked, for it is in this part of the sporophore that growth takes place. In the case of *Fomes pinicola*, even though it has a resinous coating which checks evaporation and a hymenium which absorbs more moisture from the air, the fact that very little water can be absorbed by the resinous surface of the fruiting body from the rains appears to place this fungus at a slight disadvantage when compared with *Fomes Pini*.

Polyporus ursinus is an interesting fungus with reference to water absorption and water loss. It is comparatively heavy for its unit volume even when air-dried. This species does not take up such a large quantity of water, but, like *Polyporus leucospongia*, its swelling is very pronounced (pl. 19, figs. 5–8). *Polyporus ursinus*, *Trametes odorata*, and *T. subrosea* for some reason are limited to the moist regions of the mountains. Their rates of water absorption and evaporation show relatively little of significance that might pertain to their distribution.

In conclusion to the discussion on the distribution of pore fungi in Colorado, it appears that spore germination is probably not

a limiting factor. Some data are presented for the first time which at least indicate that the water relations of species of pore fungi may be one of the important factors in restricting their altitudinal distribution. It is brought out in the preceding discussion that, at least in the Rocky Mountains, the distribution of any one species of pore fungus is not in all cases coextensive with that of its host-plant.

III. The Family Polyporaceae

MATERIALS AND METHODS

In the microscopical examination of materials, the free-hand sectioning method has been used. The procedure is briefly as follows: A small piece of the dried material to be sectioned is placed in 95 per cent alcohol for one or two minutes in order to drive out the air; it is then transferred to water and allowed to soak for several minutes, or until soft, and then cut in elder pith according to the usual procedure followed by Burt and Overholts. While cutting the sections, the razor blade is kept flooded with 95 per cent alcohol in order to prevent curling of the sections, and the cut sections are then transferred to a slide upon which was previously placed a drop of 10 per cent KOH solution. After a sufficient number of sections are thus cut and transferred to the drop of KOH on the slide, a drop of 3–5 per cent water-soluble eosin is added to the KOH; a cover glass is placed over the material, and the slide is ready to be examined under the microscope. All measurements and drawings were made from sections mounted in this eosin-KOH solution, for it was felt that the KOH swells the material to approximately natural size. In species having a dark-colored context, KOH rendered sections rather dark in color, and in mounting sections from such plants the lactophenol-cotton blue[22] mounting medium has been found to be satisfactory. This mounting medium likewise causes the material to swell to approximately that of fresh material, and in general it seems to be a superior stain for mycological work. Permanent mounts are made by using this medium.

In making observations on the hyphae of the context, the same

[22] Linder, D. H. An ideal mounting medium for mycologists. Science, N. S. 70: 430. 1929.

procedure as stated above is followed; but instead of sectioning the material, it is preferable to tease it out with needles, for this method gives a better mount for the study of hyphal characters. In fructifications with a colored context, staining is unnecessary, for the hyphae will be sufficiently colored to afford good visibility.

The material examined in the preparation of this paper covers all of the collections known from Colorado and listed elsewhere.[23] The writer's herbarium, however, which includes collections of Colorado fungi over a period of eight years, represents the nucleus of materials used in the preparation of this treatise.

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[23] Shope, P. F. History of mycological collectors in Colorado. Mycologia 21: 292–296. 1929.

pleted, and to many others who offered kind assistance, advice, and encouragement in various ways.

MORPHOLOGY AND REPRODUCTION

The family Polyporaceae belongs to the Basidiomycetes, and is characterized by having tubes or cup-like depressions which are lined internally by the hymenium. Basidiospores are the chief organs of reproduction.

Basidia are produced from the terminal cells of hyphae which extend from the trama out into the hymenium. These terminal cells become club-shaped, or remain cylindric, and are usually of a greater diameter than the cells of the hyphae immediately back of them. In most cases, the living cells and the young basidia contain two nuclei. In the basidia, these two nuclei fuse, but later and at intervals that vary with the species there usually follow two divisions (meiosis) as a result of which the basidia, as a rule, have four nuclei. By this time four sterigmata (rarely fewer) have developed on each basidium, and at the apex of each sterigma is developed a small globose swelling. A single nucleus now passes up through each of the four sterigmata into the globose swellings at their apexes.[24] These swellings are later cut off at their bases by septa and develop into spores characteristic of the species. When the spores are mature they are ready to be discharged. At this stage, according to Buller,[25] a small drop of water is formed immediately below each spore. This droplet increases in size to approximately half the diameter of the spore, and then the spore, with the droplet attached, is suddenly shot off the sterigma for a distance of from 0.1 to 0.2 mm., following which the sterigma collapses.

On the advent of suitable environmental conditions, the basidiospores swell and later send out germ-tubes which become septate and every cell usually contains one nucleus. Sooner or later, some of these primary mycelial cells conjugate with other cells and become binucleate. The two nuclei resulting from this fusion do not immediately fuse, but lie side by side and divide simultaneously during subsequent growth of the hypha. The hyphae which develop from these binucleated cells have clamp connections and

[24] Vokes, M. M. Nuclear division and development of sterigmata in *Coprinus atramentarius*. Bot. Gaz. **41**: 194–205. 1931.

[25] Buller, A. H. R. Researches on fungi. **2**: 148–152. 1922.

are known as the "secondary mycelia." Sporophores are produced after a period of extensive growth of the secondary mycelium in the substratum, during which time reserve materials are probably collected and stored. In the sporophore, some of the secondary mycelium is utilized in the formation of various tissues, in which case the cells lose their individuality and become changed in shape and structure. These tissue-like mycelia are called "tertiary mycelia."

The stimulus of gravity plays an important role in controlling the direction of growth of the fruiting bodies of fungi (see Atkinson's 'Mushrooms,' p. 15, and Buller's 'Researches,' **2**: 110.). The pore layer is positively geotropic, whereas the hymenium lining this layer is transversely geotropic. If a tree bearing sporophores is felled, subsequent growth of these sporophores will be controlled by the new stimulus established by the change in horizontal-vertical position. The positive geotropic response of the tubes appears to be an aid in the discharge and dispersal of spores. In some species of *Fomes*, fruiting layers other than the last formed one may also discharge spores.[26]

Spores other than basidiospores (asexual spores, conidia, or chlamydospores) are variously produced in the vegetative or reproductive stages when environmental conditions are suitable.[27] These spores germinate and probably give rise to new plants.

Heterothallism and homothallism, which have been definitely proved for many species of gill fungi, have received little attention in the pore fungi. Heterothallism has been shown by Mounce[28] to occur in several species of the Polyporaceae.

CLASSIFICATION

The family limitations of the Polyporaceae followed in this paper are those of Gaümann and Dodge.[29] Killermann,[30] in a

[26] Buller, A. H. R. Researches on fungi. **2**: 108. 1922.

[27] Snell, W. H. Chlamydospores of *Fomes officinalis* in nature. Phytopath. **11**: 173–174. 1921.

[28] Mounce, Irene. Notes on sexuality in *Fomes pinicola*, *F. roseus*, *Polyporus Tuckahoe*, *P. resinosus*, *P. anceps*, *Lenzites saepiaria*, *Trametes protracta*, and *T. suaveolens*. Can. Phytopath. Soc. Proc. **1929**: 27–28. 1930.

[29] Gaümann, E. A. & C. W. Dodge, Comparative morphology of the fungi. p. 430. New York, 1928.

[30] Killermann, S. in Engler, A. & K. Prantl, Die Natürlichen Pflanzenfamilien. **6**: 169. Leipzig, 1928.

recent issue of 'Die Natürlichen Pflanzenfamilien,' following the classification previously used in that series of publications, includes in the family the tribes Merulieae, Fistulineae, and Boleteae, as well as Polyporeae.

Genera of the Polyporaceae found in Colorado are: *Polyporus* (including *Polystictus*), *Fomes*, *Lenzites*, *Trametes*, *Favolus*, *Ganoderma*, and *Poria*. *Polyporus* and *Favolus* are always annual plants, whereas all the others listed may be annual or perennial. *Lenzites*, when perennial, does not have stratified lamellae-layers, whereas in all the other perennial genera the annual increments of growth are stratified. *Poria* is always resupinate. *Ganoderma* has a varnished or dull, thick crust, and the spores are always truncate and have a colored spiny endospore and a hyaline smooth exospore which collapses and gives the spore a spiny or warty appearance. *Fomes* is always perennial, but one-year-old sporophores may be confused with strictly annual genera. *Trametes* may be annual or perennial, but usually the sporophores are not as large as those of *Fomes*, and generally not ungulate. The genus *Trametes*, in most cases, differs from all other genera in the family by the fact that the tubes are joined to the context in an uneven line, so that they appear to be sunken into the context to unequal depths. This genus is a poorly marked one and it would probably be much better to disregard it entirely. Nevertheless, it is still used and recognized, and hence will be used in this paper. No trouble, however, should be experienced in the use of the key, for all species of the genus *Trametes* are included in the key to the species of *Polyporus*. Of the annual forms, *Polyporus* most frequently has circular or angular pore-mouths, whereas *Favolus* has large radially arranged and radially elongated ones. Following the procedure of Overholts[31] and Rhoads,[32] the genus *Polystictus* is not recognized on account of its indefinite and transitional character. A historical account of this family and its genera may be found elsewhere.[33]

[31] Overholts, L. O. Polyporaceae of the middle-western United States. Wash. Univ. Studies 3: 3–96. 1915.

[32] Rhoads, A. S. The biology of *Polyporus pargamenus* Fr. N. Y. State Coll. For. Tech. Publ. No. 11. 18: 15. 1918.

[33] Overholts, L. O. Comparative studies in the Polyporaceae. Ann. Mo. Bot. Gard. 2: 667–671. 1915.

Following American usage, the old established generic names are used throughout this paper. Of the various segregates that have been proposed, the genus *Ganoderma* appears to be well marked. Its macro- and microscopical characters are sufficiently distinct to warrant its segregation. This genus is the only one of the many segregates that has met with at least partial acceptance in America.[34]

Additional genera, as *Cyclomyces*, *Daedalea*, and others, are found in the family Polyporaceae, but since they have not as yet been reported from Colorado a consideration of them is unnecessary here.

Up to comparatively recent times, the classification of the Polyporaceae was based only on external appearances. This system became unsatisfactory partly because of the great increase in the number of species, and also because of the change in the gross morphology induced by different environments. Recently, the microscopical structures of the fructifications have been taken into consideration, along with the macroscopical ones, thus defining species more clearly and definitely. Microscopical structures have been used by Burt[35] in his work with the Thelephoraceae; by Kauffman[36, 37] with the Agaricaceae and Clavariaceae; and by Bourdot and Galzin[38] with the Hymenomycetes in general. Overholts[39] has brought together and described the various microscopical characters used in the taxonomy of the Hymenomycetes. For convenience, a brief description of the microscopical characters used in this paper will follow.

In the Polyporaceae, hyphae vary in thickness from 1.5 to 15 microns. In a particular species, variations in hyphal thickness usually fall within comparatively narrow confines, the tramal hyphae being somewhat thinner than those of the context. Also,

[34] Haddow, W. R. Studies in Ganoderma. Jour. Arnold Arbor. 12: 25–46. 1931.

[35] Burt, E. A. Thelephoraceae of North America. Ann. Mo. Bot. Gard. 1–13. 1914–26.

[36] Kauffman, C. H. The Agaricaceae of Michigan. Mich. Geol. and Biol. Survey, Publ. 26. Biol. Ser. 5. 1918.

[37] ————, Cystidia in the genus Clavaria and some undescribed species. Mich. Acad. Sci., Arts and Letters, Papers 8: 141–151. 1927.

[38] Bourdot, H. & A. Galzin, Hyménomycètes de France. Paris, 1927.

[39] Overholts, L. O. Research methods in the taxonomy of the Hymenomycetes. Proc. Internat. Cong. Pl. Sci. 2: 1688–1712. 1929.

thick-walled "vascular" hyphae, with apparently no cross-walls, may be of slightly greater diameter than ordinary vegetative hyphae. Septations are often difficult to see and apparently absent in some hyphae. Thickness of cell-walls is also variable; it is not uncommon to find cell-walls of greater thickness than the diameter of the lumen. The walls may be nodose or smooth.

Hyphae within a given field of the microscope are found to be branched or simple; occasionally, they are dichotomously or otherwise branched and in some few cases, hyphal complexes are found. In these complexes, the hyphal branches are numerous and of smaller diameter than the parent hypha from which they spring. Hyphal fusions are sometimes observed, in which case the hyphae fuse in a manner similar to the letter H.

Clamp connections may be abundant or apparently absent depending upon the species. Where the hyphae are of extremely small diameter, these clamp connections are visible only under the oil immersion lens. They may appear over every septum in a hypha, or else widely scattered.

Incrusted hyphae are not extremely frequent in the Polyporaceae. When present, they have small, colorless, crystalline bodies attached to the outside of their wall and which are sometimes completely soluble in KOH solution. Incrusted cystidia (pl. 19, fig. 8) are often encountered. Occasionally, crystalline bodies having a diameter several times that of the hyphae may be found in the trama (*Lenzites serpens* Fr.).

Setae and cystidia are prominent sterile organs found in the hymenium or trama. They usually extend beyond the general limit of the hymenium, and differ from each other only in color, especially after KOH solution has been added. When mounted in KOH solution, cystidia appear hyaline, yellowish, or light brown under the microscope; whereas setae appear very dark brown to black. In the following line drawings of these organs, cystidia are outlined, whereas setae are shaded. Both setae and cystidia may or may not be incrusted. Setae are found only in species having dark-colored contexts, whereas cystidia are found in species having either light- or dark-colored contexts.

Hyphal pegs are compound hyphal fasciculate projections extending beyond the general level of the hymenium (pl. 17, fig. 2).

These pegs are made up of two or more hyphae arranged parallel to each other, or else interwoven. The hyphae may or may not be incrusted or gelatinized.

Paraphyses in the Polyporaceae are usually either club-shaped or cylindric and show little difference in form or structure in different genera and species. They are seldom found to have characteristic markings or shapes as are found in many species of *Aleurodiscus* of the Thelephoraceae. Taxonomically, they are of little value in this family.

When sections of *Polyporus alboluteus, P. fibrillosus,* and probably some other species, are mounted in KOH solution, the tramal tissue turns a deep red. With these and some other species this reaction is of taxonomic value; also, the same color-change occasionally takes place in *Fomes pinicola,* but in this case it is not a dependable taxonomic character.

As has been stated previously, KOH solution turns the hyphae of species with a brown context to a markedly darker color. While this is not of great taxonomic importance here, in related families within the order the reaction of KOH solution on the hyphae has proved of value.

The presence of a black line in the context of several species of pore fungi appears to be a constant factor of taxonomic importance. Such a black line is found in *Fomes nigrolimitatus, F. conchatus, Trametes stereoides, Polyporus ovinus,* and *P. osseus.*

In general, an attempt has been made to follow the International Rules for Nomenclature.

Ridgway's[40] 'Color Standard and Color Nomenclature' has been used in the following scientific descriptions, in which case the first letter of the color-name is always capitalized.

KEYS AND DESCRIPTIONS

KEY TO THE GENERA

Sporophores entirely resupinate and remaining so throughout the growing period ..... *Poria* (p. 395)

Sporophores not resupinate; stipitate, sessile, or effused-reflexed 1

1. Spores minutely spined; surface of the pileus covered with a shiny or dull thick crust ..... *Ganoderma* (p. 373)

Spores smooth; surface of the pileus anoderm or covered with a thin crust 2

[40] Ridgway, R. Color standard and color nomenclature. Washington, D. C. 1912.

2. Pore-mouths angular, large, and radially elongated; stipe short, lateral, or excentric.....*Favolus* (p. 394)
   Pore-mouths circular or angular, usually small, not radially elongated; stipe present and central or excentric, or entirely absent.....3
3. Plants perennial; poroid; producing a new layer of tubes each year.....4
   Plants perennial; lamellate.....*Lenzites* (p. 390)
   Plants annual; producing only one layer of pores.....5
4. Sporophores large and massive; ungulate.....*Fomes* (p. 376)
   Sporophores smaller than above; not usually ungulate.....*Trametes* (p. 362)
5. Fruiting layer definitely poroid.....6
   Fruiting layer more or less lamellate.....*Lenzites* (p. 390)
6. Tubes joined to the context along a straight line.....*Polyporus* (p. 317)
   Tubes joined to the context along an uneven line, *i.e.* tubes are sunken to unequal depths in the context.....*Trametes* (p. 362)

POLYPORUS

Polyporus (Mich.) Fries, Syst. Myc. **1**: 341. 1821; Mich. Nov. Plant. Gen. p. 129. 1729.

Plants annual, terrestrial, or lignicolous, sessile, effused-reflexed, or stipitate, fleshy, coriaceous, or woody; context of various thicknesses and colors, homogeneous or duplex, zonate or azonate; context and tramal tissue different in structure; tubes joining the context in a straight line; pore-mouths circular to irregular, rarely daedaloid or favoloid; edge of the dissepiments even, dentate, or toothed; spores variously shaped and colored; cystidia, setae, and hyphal pegs present or absent.

As defined in this paper, the genera *Polyporus* and *Favolus* contain only annual plants, whereas all other genera of the family considered in this treatise are either annual or perennial except *Fomes*, which is always at length perennial.

It is very difficult to draw definite lines of distinction between the genera *Polyporus* and *Trametes*, and in all probability no well-marked ones exist. It seems advisable, however, to retain the genus *Trametes*, due to the fact that it still meets with favor. Hence, in order to avoid confusion, all species of the genus *Trametes* are keyed out in the key to the species of *Polyporus* as well as in the key to the species of *Trametes*.

The various synonyms of this genus may be obtained from the lists of synonyms accompanying the following species.

KEY TO THE SPECIES[a]

Sporophores sessile or effused-reflexed; never stipitate.....SECTION 1 (p. 318)
Sporophores centrally, excentrically, or laterally stipitate.....SECTION 2 (p. 320)

SECTION 1

Context white, whitish, very light yellow or light wood-color.....Subdivision I
Context yellowish-red or reddish.....Subdivision II
Context brown, darker than wood-color.....Subdivision III

Subdivision I

Sporophores globose or door-knob shaped; hymenium internal and enclosed by a volva.....*1. P. volvatus*
Sporophores not as above.....1
1. Surface of the pileus in dried plants dark brown, dark reddish-brown, or blackish-brown; context white, very light brown or yellowish-brown.....2
Surface of the pileus white, whitish, gray, yellowish, or light brown.....8
2. Context more than 1 mm. thick; pileus usually more than 1 cm. thick.....3
Context less than 1 mm. thick; pileus always less than 1 cm. thick.....5
3. Surface azonate; cystidia present and incrusted; plants sodden when fresh. .....*9. P. ursinus*
Surface with age becoming zonate; cystidia absent; plants sodden or not sodden when fresh.....4
4. Surface fibrillose; plants sodden when fresh; pores 3–4 per mm.; plants small, usually less than 7 cm. in diameter.....*18. P. fragilis*
Surface velvety-tomentose; not sodden when fresh; plants larger than the above.....*15. P. resinosus*
5. Tubes less than 2 mm. long; pileus zonate, and multicolored.....6
Tubes more than 2 mm. long; pileus azonate or zonate, but not multicolored..7
6. Zones brown, reddish-brown, black, purple, greenish, or yellowish, some zones glabrous or nearly so.....*2. P. versicolor*
Zones alternately villous-cinereous and orange-glabrous or nearly so .....*4. P. zonatus*
Zones alternately brown and black.....*21. P. planellus*
7. Mouths of tubes averaging 3 or more per mm.....*37. Trametes serialis*
Mouths of tubes averaging 1–2 per mm.....*38. Trametes variiformis*
8. Hymenium more or less smoke-colored or black.....9
Hymenium not as above.....11
9. Hymenium eventually turning to a dark smoke-color, or nearly black.....10
Hymenium very light gray or smoke-colored.....*3. P. hirsutus*
10. Margin of the pileus crisped and wavy; pileus strigose towards the base, adpressedly fibrillose on the margin; sporophores always densely imbricated.....*17. P. crispus*
Margin of the pileus even, finely tomentose; sporophores usually not densely imbricated.....*16. P. adustus*
11. Pileus markedly zonate with alternate hirsute and pubescent zones.....12
Pileus azonate, or if zonate, not with alternate hirsute and pubescent zones..13

[a] A key based on the microscopical characters of the hymenium will be found interspersed with the descriptions of the species. This key represents the probable natural affinities within the section.

12. Pileus made up of many multicolored zones; margin of pileus usually white or yellowish and lighter than the rest.....*2. P. versicolor*
Margin of the pileus concolorous; zones alternate villous-cinereous and orange-glabrous.....*4. P. zonatus*
13. Surface of the pileus soft and spongy; more or less watery and sodden when fresh.....14
Surface of the pileus not as above; not sodden when fresh.....17
14. Tubes markedly collapsed when dry; plants fragrant when fresh...*22. P. spumeus*
Tubes only slightly or not at all collapsed when dry; plants not fragrant when fresh.....15
15. Cystidia present, extending only slightly beyond the basidia.....*12. P. borealis*
Cystidia absent.....16
16. Tubes turning blue when touched or bruised, drying caesius; context not duplex.....*14. P. caesius*
Tubes not turning blue when touched or bruised; context duplex, cottony above, horny below.....*5. P. leucospongia*
17. Mouths very large, 1 mm. or more in diameter, white or yellowish; dissepiments often lacerate.....*39. Trametes heteromorpha*
Mouths less than 1 mm. in diameter; dissepiments lacerate or not lacerate...18
18. Dissepiments with age lacerate; hymenium when young purplish, becoming yellowish with age.....19
Dissepiments with age not becoming lacerate; hymenium never purplish in color.....21
19. Pileus less than 4 mm. thick.....20
Pileus more than 4 mm. thick.....*8. P. subchartaceus*
20. Pileus usually conchate and attached to the substratum by a stalk-like attenuation; usually found growing on deciduous hosts.....*7. P. pargamenus*
Pileus dimidiate and never with a stalk-like base; usually found growing on conifers.....*6. P. abietinus*
21. Pileus when fresh becoming brown-spotted when touched.....*18. P. fragilis*
Pileus when fresh not becoming brown-spotted when touched.....22
22. Pileus hirsute, white, yellowish-brown, or gray; azonate or indistinctly zonate; usually sessile.....*3. P. hirsutus*
Pileus adpressedly-tomentose, yellow or brown, effused-reflexed with a narrow reflexed portion.....*37. Trametes serialis*
Pileus minutely downy, white to cream-colored.....*20. P. anceps*

Subdivision II

Plants soft and spongy when fresh, drying brittle; on dead wood of conifers; turn red when KOH solution is added.....1
Plants tough or rigid when fresh, drying coriaceous to rigid; found on both coniferous and deciduous hosts; do not turn red when KOH is added.....2
1. Pores large, 1–3 mm. broad, dissepiments soon becoming lacerate; tubes 1–3 cm. long; plants mostly resupinate with occasionally a narrow reflexed margin.....*10. P. alboluteus*
Pores smaller than the above, 1–2 per mm., dissepiments becoming lacerate; tubes 2–6 mm. long; plants sessile.....*11. P. fibrillosus*
2. Pileus orange to cinnabar-red, fading with age; tubes 1–5 mm. long; mouths cinnabar-red; on deciduous wood.....*19. P. cinnabarinus*
Pileus rose-colored to brownish; tubes indistinctly stratified in old plants; mouths rose-colored; mainly on conifers.....*43. Trametes subrosea*

Subdivision III

Context light brown (if very light yellowish-brown, see Sub. I.).....1
Context darker; cinnamon-brown to rusty-brown.....7
1. Pileus covered with a dense brown strigose pubescence....*41. Trametes hispida*
Pileus not clothed as above, velvety-tomentose to glabrous.....2
2. Context less than 1 mm. thick.....4
Context more than 1 mm. thick.....3
3. Mouths averaging 4–6 per mm., circular.....*15. P. resinosus*
Mouths averaging 1–2 per mm., usually daedaloid to labyrinthiform.
.....*56. Lenzites trabea*
4. Dissepiments becoming lacerate with age; hymenium purplish in young specimens.....5
Dissepiments not becoming lacerate; hymenium brownish.....6
5. Pileus usually conchate and attached to the substratum by a stalk-like attenuation; usually found growing on deciduous hosts.....*7. P. pargamenus*
Pileus dimidiate and never with a stalk-like base; usually found growing on conifers.....*6. P. abietinus*
6. Mouths averaging 5–6 per mm.....*21. P. planellus*
Mouths averaging 1 per mm.....*40. Trametes stereoides*
7. Setae present; cystidia absent; on coniferous wood only.....8
Cystidia present; setae absent; growing on coniferous wood or on the ground near coniferous trees; usually stipitate, but not always...
.....*24. P. Schweinitzii*
Neither setae nor cystidia present in the hymenium.....11
8. Context containing a thin black line which is less than 1 mm. thick.....9
Context not containing a black line as above.....10
9. Fungus confined to coniferous hosts.....*47. Fomes nigrolimitatus*
Fungus confined to deciduous hosts.....*50. Fomes conchatus*
10. Spores globose to subglobose; margin yellowish, pileus dark brown
.....*46. Fomes Pini*
Spores cylindric; margin concolorous with the surface of the pileus.
.....*36. Trametes isabellina*
11. Context containing a central granular core.....*13. P. Rheades*
Context homogeneous.....12
12. Dissepiments thin, less than 200 μ.....*56. Lenzites trabea*
Dissepiments very thick, more than 200 μ.....*42. Trametes odorata*

SECTION 2. Stipitate

Context white, whitish, very light yellow, or light brown.....Subdivision I
Context dark-brown.....Subdivision II
Context pinkish or reddish in color.....*27. P. confluens*

Subdivision I

Stem black at the base.....1
Stem not black at the base.....3
1. Pileus large, 10 cm. or more in diameter; pileus covered with appressed scales; pores very large and angular, 1–4 mm. broad.....*31. P. squamosus*
Pileus smaller than the above; no scales present.....2
2. Pileus glabrous or pruinose; concolorous throughout.....*34. P. elegans*
Pileus radially fibrillose; at times multicolored with reddish-brown or blackish splotches, especially near the margin.....*33. P. varius*

3. Context duplex, cottony above, horny below in dried plants; pileus and stem fawn-colored, hirsute; setae present.....*25. P. circinatus*
Context not duplex; no setae present.....4
4. Context in fresh plants white to light rose-color, occasionally reddish next to the tubes, drying pinkish.....*27. P. confluens*
Context white in fresh plants and not turning pinkish on drying.....5
5. Stem central or excentric, never lateral.....6
Stem lateral.....7
6. Pileus white or grayish-white, less than 5 cm. in diameter and 3–4 mm. thick; stipe obese; pileus not becoming black-spotted on drying; plants usually attached to dead grass roots.....*30. P. cryptopus*
Pileus white or tan, larger than the above, usually more than 5 cm. in diameter and 3–10 mm. thick; stipe obese; pileus becoming black-spotted on drying.....*26. P. ovinus*
Pileus golden-brown to dark-brown; growing on deciduous wood..*23. P. arcularius*
Pileus purplish to grayish-brown; growing on the ground and attached to buried wood.....*32. P. hirtus*
7. Plants growing on the ground and attached to buried wood; pileus 5–14 cm. in diameter; purplish to grayish-brown.....*32. P. hirtus*
Plants wood-inhabiting; pileus less than 5 cm. in diameter; pilei imbricated. .....*35. P. osseus*

Subdivision II

Context less than 1 mm. thick; plants growing on the ground.....1
Context more than 1 mm. thick; plants growing on wood or attached to buried wood.....2
1. Surface of the pileus shining and with a silky striation, reddish brown .....*29. P. cinnamomeus*
Surface of the pileus not shining, not silky, dull brown.....*28. P. perennis*
2. Context decidedly duplex; setae present.....*25. P. circinatus*
Context not duplex; cystidia present; setae absent.....*24. P. Schweinitzii*

Section I. Sporophores sessile or effused-reflexed, never stipitate.

I. Hemiangiocarpeae.

1. Polyporus volvatus Pk. Ann. Rept. N. Y. State Mus. **27:** 98. 1877.

Polyporus obvolutus Berk. & Cooke, Grevillea **7:** 1. 1878.

Polyporus inflatus Ellis & Mart. Am. Nat. **18:** 722. 1884.

Polyporus volvatus Helix P. Henn. Hedwigia **37:** 273. 1898.

Ungulina volvata (Pk.) Pat. Ess. Tax. Hymen. p. 102. 1900.

Cryptoporus volvatus (Pk.) Shear, Bull. Torr. Bot. Club **29:** 450. 1902.

Ungulina volvata var. *pleurostoma* (Pk.) Pat. Bull. Soc. Myc. Fr. **23:** 74. 1907.

Plate 16, fig. 1.

Pileus globose or compressed globose, sessile or very rarely stipitate, usually growing from insect bore-holes, 1–3 x 1–6 x 1–4 cm.; upper surface at first resinous, shining, becoming cracked, Light Ochraceous-Buff to Stanford's Brown; the resinous secretion may extend down over the volva, but it soon flakes off, revealing the soft, pubescent, white to Light Pinkish Cinnamon context; margin rounded and continuous with the volva, volva at first unbroken, later there develops 1 (rarely 2 or 3) circular or irregular (rarely elongated) openings, 3–6(10) mm. in diameter; context white, drying Light Buff to Warm Buff, 2–10 mm. thick, hyphae of the context grayish under the microscope, branched, undulating, 3–4 μ in diameter; tubes at first white, with age and on drying turning Light Ochraceous-Buff to Yellow Ocher, attenuated at the mouths into a very small opening, 2–10 mm. long; mouths very small, at first white, later Wood Brown, Snuff Brown to Brussels Brown, circular to angular, averaging about 3 per mm.; dissepiments grayish under the microscope, tapered, thickest at the mouths, mouth-end abruptly angled and often flat; hymenium 16–20 μ thick, loosely arranged, covering the bottom and sides of the tubes, occasionally also over the ends of the dissepiments; basidia 6–8 μ in diameter, hyaline; spores smooth, hyaline under the microscope, oblong-ellipsoid, apiculate, 10–13(15) x 4.5–6 μ.

Habitat: on various coniferous hosts.

Occurrence: uncommon. Spring.

Distribution: foothills and montane zones. Wide-spread throughout the coniferous regions of the United States.

Type of rot: white rot.

Polyporus volvatus is hemiangiocarpous in its development and thus forms a natural connecting-link with the Boletaceae of the Agaricales. The occasional presence of the hymenium on the free ends of the dissepiments indicates a conection with *Merulius*.

This fungus has been collected several times upon recently wind-felled rock pines (*Pinus scopulorum*) upon which the green needles still persisted. Such collections would indicate at least a partial parasitic relation between the fungus and the host which has previously been noted by Schmitz.[42]

[42] Schmitz, H. Jour. Gen. Physiol. 3: 795–796. 1921.

Insects probably play an important role in the distribution of the spores. They enter the volva through the opening, evidently to feed upon the discharged spores which have collected on the inside of the volva and thus their bodies become dusted over with the spores as they crawl around in the inside of the volva.

Zeller[43] has noted hyaline, pyriform, or oval conidia in this species.

II. Gymnocarpeae.

1. Hyphal pegs present; no cystidia or setae; spores 5–8 μ long.

2. Polyporus versicolor (L.) Fries, Syst. Myc. **1**: 369. 1821.
Boletus versicolor L. Sp. Pl. p. 1176. 1753.
Polyporus hirsutulus Schw. Trans. Am. Phil. Soc. II. **4**: 156. 1832.
Polystictus azureus Fries, Nov. Symb. p. 93. 1851.
Coriolus versicolor (L.) Quél. Ench. Fung. p. 175. 1886.
Polystictus versicolor (L.) Sacc. Syll. Fung. **6**. 253. 1888.
Coriolus hirsutulus (Schw.) Murr. Bull. Torr. Bot. Club **32**: 643. 1906.

Plate 16, fig. 2.

Pilei coriaceous, imbricate, sessile or occasionally effused-reflexed, sometimes connate, dimidiate or conchate, frequently narrowed at the base and attached to the substratum by a stalk-like attenuation. 1–6 x 1–8 x 0.1–0.5 cm. (larger in the tropics); surface concentrically zonate, at first velvety tomentose, Pale Smoke Gray, Smoke Gray, Cinnamon-Buff or Clay Color; later and on expanding the tomentum is pulled away, revealing nearly glabrous, shining zones of various colors, as yellowish, brownish, reddish, and blackish; margin thin, entire or undulating, occasionally sterile below; context thin, 0.5–2 mm. thick (thicker in the tropics), white, hyphae of the context radially arranged, rarely branched, thick-walled, 5–11 μ in diameter; tubes 0.2–2(4) mm. long; mouths angular, irregular, white, Pallid Brownish Drab, Pinkish Buff to Tawny-Olive, averaging 3–5 per mm.; dissepiments entire, becoming slightly lacerate, 65–120 μ thick; hymenium 14–17 μ broad, compact; basidia 4–5 μ broad, projecting

[43] Zeller, S. M. Mycologia **7**: 121–125. 1915...

up to 5 μ; spores smooth, hyaline, oblong-allantoid, 5–8 x 1.5–2.5 μ; hyphal pegs present, hyaline, usually incrusted, and hyphae scarcely discernible, projecting up to 40 μ, 18–25 μ in diameter.

Habitat: deciduous wood; rarely on coniferous wood. Parasitic and saprophytic.

Distribution: plains and foothill zones. Widespread in the United States.

Occurrence: common. Spring and early summer.

Type of rot: white rot.

The surface of the pileus of *Polyporus versicolor* is made up of concentric and variously colored zones. It is, indeed, a beautiful plant when fully expanded and developed. A young and undeveloped plant does not show these variously colored zones, but is indistinctly zoned and tomentose over its entire surface. Such specimens are easily confused with *Polyporus hirsutus*, but collections having specimens of this nature will usually also have a few showing the variously colored zones. *Polyporus versicolor* differs from *P. zonatus* in that the zones of the latter species are orange or reddish-orange in color and never multi-colored as in the former species.

It is evident that *Polyporus versicolor*, *P. zonatus*, and *P. hirsutus* are all closely related, as is shown by the similarity of their microscopical structures. Hyphal pegs, spore size and shape, as well as other microscopical characters, are identical in all three plants. The differences in these three species lie primarily in the pubescence, zonation, and color of the surfaces of the pilei.

The biology of this species has been studied by Bayliss.[44]

3. **Polyporus hirsutus** (Wulf.) Fries, Syst. Myc. **1**: 367. 1821.
   Boletus hirsutus Wulfen, in Jacq. Coll. **2**: 149. 1788. Not *Boletus hirsutus* Scop. 1772.
   Boletus nigromarginatus Schw. Schr. Nat. Ges. Leipzig **1**: 98. 1822.
   Polystictus hirtellus Fries, Nov. Symb. p. 83. 1851.
   Polystictus hirsutus (Wulf.) Sacc. Syll. Fung. **6**: 257. 1888.
   Coriolus nigromarginatus (Schw.) Murr. Bull. Torr. Bot. Club **32**: 649. 1906.

Plate 17, fig. 3.

[44] Bayliss, J. S. Jour. Econ. Biol. **2**: 1–22. 1908.

Pileus coriaceous to rigid, sessile or effused-reflexed, applanate, dimidiate or flabelliform, imbricate or solitary, 1–5 x 1–7 x 0.2–3 cm.; surface concentrically furrowed and zoned, erect-hirsute to fibrillose, occasionally with multicolored zones, but never with alternate multicolored glabrous and hirsute zones, color various, Yellow Ocher, Cinnamon-Rufus, Tawny to Grayish Olive or Pale Smoke Gray; margin either thin, entire or undulate, or thick and sharply rounded, finely tomentose, sterile below; context corky, sometimes zonate, white to Light Buff, 0.5–20 mm. thick (not including the tomentum), hyphae of the context hyaline, thick-walled, undulate, branched, 3–6 μ in diameter; tubes white, Light Buff or Pale Smoke Gray, 1–5 mm. long; mouths circular to angular, averaging 3–4 per mm., white, Warm Buff, Clay Color, Buckthorn Brown, Pale Neutral Gray, or some other shade of light smoke color; dissepiments 80–160 μ thick; hymenium 12–16 μ thick, closely compact; basidia 5–6 μ broad; spores smooth, hyaline, cylindric or allantoid, 6–8(10) x 2–3 μ; hyphal pegs occasionally present, hyaline, usually incrusted, hyphae scarcely discernible, projecting up to 50 μ, 12–18 μ in diameter.

Habitat: various deciduous hosts, especially cottonwoods (*Populus* spp.) and aspen (*Populus tremuloides*); known to occur on *Abies*.

Distribution: from the plains zone up to the subalpine zone. Widespread in the United States.

Occurrence: common. Spring.

Type of rot: white rot.

The above description of *Polyporus hirsutus* represents the species in its broadest sense, and undoubtedly several segregates could be made. The thin *Polystictus*-like form is commonly encountered at low elevations, whereas a thick form with a light smoke-colored hymenium is found on aspen (*Populus tremuloides*) and narrow-leaved cottonwood (*Populus angustifolia*) at high elevations. The multicolored form, which is of uncommon occurrence, may easily be confused with *Polyporus zonatus*. The latter species, however, has a pronounced orange color, whereas *P. hirsutus* is white, gray, or pale yellowish in color.

4. Polyporus zonatus Fries, Syst. Myc. 1: 368. 1821.
Coriolus zonatus (Fr.) Quél. Ench. Fung. p. 175. 1886.

Polystictus zonatus (Fr.) Sacc. Syll. Fung. **6**: 260. 1888.
Coriolus Lloydii Murr. N. Am. Fl. **9**: 23. 1907.
Polyporus Lloydii (Murr.) Overh. Wash. Univ. Studies **3**: 32. 1915.

Plate 16, fig. 3.

Pilei coriaceous, sessile or effused-reflexed, rarely connate, dimidiate or conchate, often narrowed at the base and attached by a stalk-like attenuation, 1–4 x 1–7 x 0.2–0.5 cm.; surface usually concentrically zonate with zones alternately adpressedly tomentose (rarely erect-tomentose) and glabrous, tomentose zones Pale Smoke Gray to Mouse Gray, glabrous zones Ochraceous-Buff to Zinc Orange; margin thin, entire or undulating, often as dark as Hazel or Kaiser Brown; context white, 0.5–2 mm. thick, hyphae of the context hyaline under the microscope, sparingly branched, 5–8(10) μ in diameter; tubes 1–3 mm. long, concolorous with the mouths; mouths white, Ochraceous-Buff to Ochraceous Tawny, angular, averaging 3 per mm.; dissepiments becoming lacerate with age, 60–160 μ thick; hymenium 12–16 μ thick, compact; basidia 5–6 μ broad; spores smooth, hyaline, oblong-allantoid, 6–8 x 2–3 μ; hyphal pegs present, hyaline, usually incrusted, hyphae scarcely discernible, projecting up to 40 μ and 12–18 μ in diameter.

Habitat: deciduous hosts.

Distribution: plains and foothill zones. Southern United States.

Occurrence: uncommon.

Type of rot: white rot.

When mature, this fungus is characterized by its thin pileus and alternately tomentose cinereous and glabrous reddish-orange-zoned surface. In young specimens, however, these glabrous zones are not evident. This species differs from *Polyporus hirsutus* in having a pronounced orange-colored pileus and thus approaches *Polyporus pubescens*.

5. Polyporus leucospongia Cooke & Hark. Grevillea **11**: 106. 1883.

Spongiporus leucospongia (Cooke & Hark.) Murr. Bull. Torr. Bot. Club **32**: 474. 1905.

Plate 17, figs. 1–2.

Pileus soft, spongy, effused-reflexed, occasionally sessile, dimidiate, 0.5–3 x 1–15 x 0.5–2 cm., sometimes laterally connate for 30 cm. or more; surface velvety-tomentose, subpelliculose with age, pellicle flexuous, never horny, thrown into folds or even, azonate, white, Light Buff, Pinkish Buff to Clay Color; margin rounded and inflexed, sterile, concolorous; context duplex, white, Light Buff to Pinkish Buff, upper layer soft and cottony, lower layer hard and horny when dry, 0.3–1.5 cm. thick, cottony layer made up of loosely arranged, branching, straight, thick-walled hyphae 4–5 μ in diameter, horny layer of densely arranged, branching, interwoven, undulating, thin-walled hyphae 4–5 μ in diameter; large and conspicuous clamp connections are abundant in both regions of the context; tubes 1–4 mm. long; mouths white, Salmon Buff to Buff Pink, slightly angular, sometimes irregular, averaging 2 per mm.; dissepiments thin, entire or dentate, 100–250 μ thick; hymenium somewhat incrusted, incrustation dissolving in KOH solution; basidia 4–6(8) μ broad, projecting 0–12 μ beyond the general level of the hymenium, sterigmata 2–4 μ long; spores cylindric, straight or allantoid, smooth, hyaline, 6–8 μ x 1–1.5 μ, abundant; hyphal pegs present, composed of from 2 to 3 to 10 or more hyphae arranged parallel or interwoven, projecting 25–35 μ above the level of the hymenium.

Habitat; dead coniferous wood, especially *Picea Engelmanni*.

Distribution: montane and subalpine zones. Found mainly in the Rocky Mountain region and the western Coastal Ranges.

Occurrence: common. Throughout the year.

Type of rot: white rot.

This fungus is very common in the moist Engelmann spruce belt, and occasional specimens may be found at lower elevations. The margin of the pileus is usually inflexed, and at times it almost encloses the tube-layer. The fructifications are usually effused-reflexed, in which case the effused area is greater than the reflexed area; less frequently the growth-form is sessile.

2. Cystidia present, no hyphal pegs or setae.

A. Cystidia with globose incrusted apexes.

a. Spores cylindric-ellipsoid, 7–9 μ long.

6. Polyporus abietinus (Dicks.) Fries, Syst. Myc. **1**: 370. 1821.
Boletus abietinus Dicks. Pl. Crypt. Brit. **3**: 21. 1793.
Boletus incarnatus Schum. Enum. Pl. Saell. **2**: 391. 1803.
Polyporus parvulus Schw. Trans. Am. Phil. Soc. II. **4**: 157. 1832.
Coriolus abietinus (Dicks.) Quél. Ench. Fung. p. 175. 1886.
Polystictus pusio Sacc. & Cub. in Sacc. Syll. Fung. **6**: 265. 1888.
Polystictus abietinus Sacc. & Cub. *ibid.*
Daedalea unicolor violacea Clements, Crypt. Form. Colo. *no. 170.* 1905.
Lenzites abietis Lloyd, Mycol. Notes **6**: 909. *f. 1607.* 1920.

Plate 18, figs. 2–6.

Pileus thin, coriaceous, tough, sessile or effused-reflexed, dimidiate, 0.5–4 x 1–5 x 0.1–0.2 cm., effused part up to 8 x 10 cm., sometimes entirely resupinate; surface zonate, villous, strigose, white, Vinaceous-Buff, Avellaneous to Light Drab, often greenish due to the presence of algae; margin thin, continuous, undulating or lobed; context very thin, less than 1 mm., darker than either the pubescence or the tubes, Russet to Mikado Brown, hyphae of the context golden to brownish under the microscope, unbranched, 2–3 μ in diameter; tubes 0.5–7 mm. long, straight or oblique, drying brittle; mouths Livid Purple, Vinaceous-Fawn to Warm Blackish-Brown, purplish in young living plants, light brown in older ones, averaging 2–3 per mm. in poroid forms, round or angular, sometimes decidedly lamellate; dissepiments soon becoming lacerate, 80–150 μ thick, trama golden under the microscope; hymenium 20 μ thick, hyaline; basidia 5–7 μ broad; spores cylindric, elongate-ellipsoid to allantoid, smooth, hyaline, 7–9 x 2–3 μ; cystidia abundant or inconspicuous, hyaline, incrusted or smooth at their apexes, 5–7 μ in diameter, even with the hymenium or projecting up to 15 μ.

Habitat: various coniferous hosts; rare on deciduous ones.

Distribution: from the plains zone up to the subalpine zone. Widespread in the United States.

Occurrence: very common. Found throughout the year.

Type of rot: white rot.

Polyporus abietinus, *P. pargamenus*, and *P. subchartaceus* are closely related species which at times are difficult to separate. When young, all three species have purple-colored hymenia and continuous dissepiments. With age, however, the hymenia turn yellowish-brown in color and the dissepiments become lacerate. Furthermore, the microscopical characteristics of the hymenia of these three species are similar. *Polyporus subchartaceus* is by far the largest, thickest, and most massive plant of the three, and it can be separated on these grounds. *Polyporus abietinus* is usually found growing on conifers, whereas *P. pargamenus* usually occurs on deciduous hosts; but either species is known to occur on both coniferous and deciduous hosts. Separation based on their respective growth-forms seems to be the most logical procedure. *Polyporus abietinus* rarely exceeds 3 cm. in length, whereas *P. pargamenus* is larger, reaching 7 cm. Furthermore, the latter species is usually fan-shaped and attached to the substratum by a narrow, somewhat stalk-like attenuation, whereas the former species does not have this character; its fruiting-bodies may be somewhat fan-shaped, but the place of attachment is broader and never stalk-like.

Some taxonomists consider the lamellate form of *P. abietinus* to be a distinct species. Since in both the poroid and lamellate forms the microscopical characteristics, the host relations, and the macroscopical characteristics other than the pores, are similar, at the present time it seems advisable to consider both forms in the same species.

Polyporus abietinus is one of the first fungi to attack fallen or dead coniferous trees. The fruiting bodies have been observed on trees which have been felled only two months.

7. **Polyporus pargamenus** Fries, Epicr. Myc. p. 480. 1838.
   Polyporus prolificans Fries, *ibid.* p. 443.
   Polyporus laceratus Berk. Ann. & Mag. Nat. Hist. **3**: 392. 1839.
   Polyporus Flabellum Mont. Pl. Cell. Cuba, p. 388, *pl. 15, f. 2.* 1842.
   Polyporus Menandianus Mont. Ann. Sci. Nat. Bot. II. **20**: 362. 1843.

Polyporus subflavus Lév. *ibid.* III. **5**: 300. 1846.
Polyporus xalapensis Berk. & Curt. Jour. Bot. & Kew Misc. **1**: 103. 1849.
Polyporus Sartwellii Berk. & Curt. Grevillea **1**: 51. 1872.
Polyporus ilicincola Berk. & Curt. *ibid.* 52.
Polyporus pseudopargamenus Thuem. Myc. Univ. *no. 1102.* 1878.
Polystictus pargamenus (*pergamenus*) (Fr.) Sacc. Syll. Fung. **6**: 242. 1888.
Coriolus pargamenus (Fr.) Pat. Ess. Tax. Hymen. p. 94. 1900.
Coriolus prolificans (Fr.) Murr. N. Am. Fl. **9**: 27. 1907.

Plate 16, fig. 4.

Pileus thin, coriaceous, sessile, sometimes effused-reflexed, conchate, often narrow at the base and attached by a stalk-like attenuation, 1–7 x 1–7 x 0.1–0.3 cm.; surface zonate, villous or velvety-tomentose, white, Vinaceous Buff, Avellaneous, or Light Drab; margin thin, acute, continuous, undulated, or lobed; context very thin, 1 mm. or less, white to Buckthorn Brown, hyphae of the context hyaline to yellowish under the microscope, branched, 4–6 μ in diameter; tubes 0.5–7 mm. long, drying brittle; mouths varying in color from Livid Purple, Vinaceous Fawn, to Warm Blackish-Brown, purplish in young specimens, brownish in older ones, averaging 2–3 per mm.; dissepiments soon becoming lacerate, 80–150 μ thick; trama hyaline to yellowish under the microscope; hymenium 20 μ thick, hyaline; basidia 5–7 μ broad; spores smooth, hyaline, elongate-ellipsoid to allantoid, 7–9 x 2–3 μ; cystidia abundant or inconspicuous, hyaline, incrusted or smooth at their apexes, even with the hymenium or projecting up to 15 μ. Spores, cystidia, and basidia are the same as in *P. abietinus* (pl. 18, fig. 5).

Habitat: mainly on deciduous hosts and rarely found on conifers.

Distribution: from the foothill zone up to the subalpine zone. Widespread in the United States.

Occurrence: rare. Throughout the year.

Type of rot: white rot.

As previously stated (p. 329), this species may be confused

with *P. abietinus*. For additional differences, compare color, thickness, and branching of the hyphae of the context. This fungus, although common in the eastern United States, is rare in the Rocky Mountains, but is replaced by *P. subchartaceus*, which is considered to be a thick form of this species.

Rhoads[46] has studied the biology of this fungus.

8. Polyporus subchartaceus (Murr.) Overh. Wash. Univ. Studies **3**: 32. 1915.

Coriolus subchartaceus Murr. N. Am. Fl. **9**: 24. 1907.

Polystictus subchartaceus (Murr.) Sacc. & Trott. in Sacc. Syll. Fung. **21**: 317. 1912.

Plate 18, fig. 1.

Pileus rigid, tough, sessile to slightly effused, dimidiate to conchate, solitary or imbricate, sometimes confluent, 1–5 x 1–10 x 0.5–1 cm.; surface tomentose to strigose, indistinctly or distinctly zonate, white, Seashell Pink, Light Buff, or Mouse Gray; context white to Light Buff, duplex, hard-corky below, spongy above, 2–5 mm. thick, hyphae of the hard-corky context yellowish under the microscope, branched, 4–6 μ in diameter; tubes 2–6 mm. long; mouths round or angular, 2–3 per mm., Livid Violet in young plants, Vinaceous-Buff to Russet-Vinaceous in more mature ones; dissepiments 100–175 μ thick, soon becoming lacerate; trama golden under the microscope; hymenium 16–20 μ thick, hyaline; basidia 4–6 μ broad, level with the hymenium or projecting up to 10 μ; spores cylindric to allantoid, smooth, hyaline, 7–9 x 2–3 μ; cystidia abundant or inconspicuous, hyaline, incrusted or smooth at the apex, projecting up to 15 μ. The spores and cystidia are the same as in *P. abietinus* (pl. 18, fig. 5).

Habitat: deciduous hosts, especially aspen (*Populus tremuloides*) and cottonwoods (*Populus* spp.).

Distribution: from the plains zone up to the subalpine zone. Known mainly from the Rocky Mountain region.

Occurrence: uncommon. Spring and summer.

Type of rot: white rot.

[46] Rhoads, A. S. N. Y. State Coll. For., Tech. Publ. no. 11. **18**: 1–197. 1918.

Rhoads[46] makes *Polyporus subchartaceus* conspecific with *P. pargamenus*, considering the former species to be a thick form of the latter. The writer, however, prefers to retain *P. subchartaceus*, since it not only has a thicker context, but also a duplex one, and the latter condition does not exist in *P. pargamenus*.

b. Spores ellipsoid, 8–12 μ long.

9. Polyporus ursinus Lloyd, Syn. Apus Polyp. p. 319. *f. 650, 660.* 1915.

Plate 19, figs. 5–8.

Pileus spongy, tough, drying horny, dimidiate, effused-reflexed or sessile, solitary or imbricate, 1–6 x 2–12 x 0.5–3 cm.; surface radially appressed-fibrillose to tufted-fibrillose, glabrous with age, azonate, at first whitish or Seashell Pink, turning with age and on bruising to Onion-Skin Pink or Carob Brown; margin thick, rounded, entire, with age undulate, soon glabrous, concolorous to slightly darker; context white to Pale Pinkish Buff, soft, becoming horny on drying, 0.5–2 cm. thick, hyphae of the context closely interwoven, 3–8 μ in diameter, nodose, branched; tubes 1–6 cm. long; mouths Pale Ochraceous-Salmon, Army Brown to Natal Brown, angular, sinuate, irregular, averaging 1–2 per mm.; dissepiments 120–160 μ thick, slightly lacerate with age; hymenium 20–25 μ thick, loosely arranged; basidia 5–8 μ broad, projecting 0–5 μ above the level of the hymenium; spores ellipsoid, smooth, hyaline, 8–12 x 3.5–4.5 μ; cystidia present and numerous, cylindric (4)5–7 μ in diameter, projecting up to 30 μ, with age becoming incrusted at their apexes.

Habitat: various decorticated conifers.

Distribution: montane and subalpine zones. Coniferous regions of the United States.

Occurrence: common. Summer and autumn.

Type of rot: white rot.

Fresh specimens of this species seem unusually heavy when compared with fresh specimens of other pore fungi. When growing under suitable environmental conditions, young specimens contain so much water that when they are squeezed in the hand

[46] Rhoads, A. S. *l.c.* p. 36.

many drops of liquid may be expressed. Consequently the plant shrinks very much on drying. If the fresh plants are bruised or handled they immediately turn reddish-brown in color. A similar color-change is also recorded for *Polyporus fragilis*.

B. Cystidia long and hyphae-like.

10. Polyporus alboluteus Ellis & Ev. Bull. Torr. Bot. Club **25:** 513. 1898.

Fomes alboluteus Ellis & Ev. Proc. Acad. Phila. **1895:** 413. 1895.

Aurantiporellus alboluteus (Ellis & Ev.) Murr. Bull. Torr. Bot. Club **32:** 486. 1905.

Plate 19, figs. 1–4.

Sporophores soft, spongy, effused, occasionally narrowly reflexed, most frequently entirely resupinate, reflexed portion dimidiate, 0.5–4 x 3–15 x 1–5 cm., resupinate portion 5–50 x 5–100 cm. or more, easily separable from the substrata in long flexuous sheets; surface velvety, azonate, Orange Rufus to Stanford's Brown, sometimes becoming incrusted with age and turning black, or bleaching to almost white; context soft, spongy, homogeneous, Salmon-Orange, Orange Chrome to Orange Rufus, 0.1–3 cm. thick, composed of loosely arranged, thick-walled, branched hyphae 4–10 μ in diameter; viewed under the microscope the hyphae appear golden when mounted in water and reddish-brown when mounted in KOH solution; tubes 1–3 cm. long, concolorous, straight or oblique, drying brittle; mouths Orange Pink to Salmon Orange or darker, sometimes turning black when bruised, 1–3 mm. or more broad, angular, becoming lacerate with age; dissepiments thick, 200–600 μ; hymenium yellowish to pinkish under the microscope, 40–60 μ thick; spores elongate-ellipsoid, often apiculate, smooth, hyaline, 9–12 x 3–5 μ; cystidia abundant, hyaline, cylindric, 7–9 μ in diameter, often collapsed, projecting up to 60 μ.

Habitat: on decorticated logs of various conifers, especially *Picea Engelmanni*.

Distribution: montane and subalpine zones. Rocky Mountains and western Coastal Ranges.

Occurrence: common. Spring and summer.
Type of rot: white rot.

This fungus is usually found in a resupinate condition on the under side of decorticated Engelmann spruce logs. Occasionally, sporophores may extend up the side of the log and their margins become narrowly reflexed. This reflexed portion represents the extent of the pileus. The fungus separates easily from the substratum, and large sheets may be stripped off, often one meter or more in length. The walls of the pores soon break down into teeth, and in this stage the fungus may be mistaken for a species of *Irpex* of the Hydnaceae.

The fruiting-bodies of *Polyporus alboluteus*, *P. fibrillosus*, and *P. cinnabarinus* are all red or reddish in color. They can be conveniently separated from one another by the size of their pores: *P. alboluteus* has pores 1–3 mm. broad, *P. fibrillosus* has pores 1–2 per mm., and *P. cinnabarinus* has pores 2–4 per mm.

11. Polyporus fibrillosus Karst. Sydv. Finl. Polyp. p. 30. 1859.
Polyporus aurantiacus Peck, Ann. Rept. N. Y. State Mus. **26**: 69. 1874.
Inonotus fibrillosus Karst. Bidr. Finl. Nat. Folk **37**: 72. 1882.
Polyporus Shiraianus P. Henn. Bot. Jahrb. **28**: 269. 1900.
Pycnoporellus fibrillosus (Karst.) Murr. Bull. Torr. Bot. Club **32**: 489. 1905.

Plate 17, figs. 4–5.

Pileus soft and spongy when fresh, fragile when dry, sessile, dimidiate, imbricate, 3–6 x 4–10 x 0.5–2 cm.; surface fibrillose, zonate, Brazil Red to Vinaceous-Rufus; context spongy-friable when dry, sodden when wet, indistinctly zonate, concolorous with the surface of the pileus or slightly lighter, 0.5–1.5 cm. thick, hyphae of the context turning red in KOH solution and appearing pinkish under the microscope, branched, undulating, 7–10 μ in diameter; tubes 2–6 mm. long; mouths Brazil Brown, fading with age to Light Salmon-Orange or lighter, angular and unequal, 1–2 per mm.; dissepiments becoming lacerate with age, 125–175 μ thick, red-colored in KOH solution, pinkish under the microscope; hymenium 20–30 μ thick, compact; basidia 4–6 μ broad, 4-spored;

spores hyaline, smooth, elongate-ellipsoid, sometimes apiculate, 5–7 x 3–4 μ; hair-like cystidia abundant, hyaline, cylindric, 4 μ in diameter and projecting up to 60 μ beyond the hymenium.

Habitat: coniferous hosts; rare on *Betula*.

Distribution: Pagosa Springs, Colorado. Northern United States.

Occurrence: rare.

Type of rot: brown rot.

The only known collection of this fungus from Colorado was made by Bethel, in 1897, at Pagosa Springs, Colorado. It is a rare fungus throughout the United States.

Polyporus fibrillosus differs from *P. alboluteus* mainly in that the former species has smaller pores.

C. Cystidia ventricose, often buried in the hymenium and rare.

12. Polyporus borealis Fries, Syst. Myc. **1**: 366. 1821.
Spongipellis borealis (Fr.) Pat. Ess. Tax. Hymen. p. 84. 1900.

Plate 20.

Pileus sodden when fresh, drying friable to rigid, dimidiate or substipitate with an attenuated base, 3–12 x 4–20 x 1–4 cm.; surface hispid to tomentose, spongy, azonate, white to Light Ochraceous-Buff or Apricot Buff; margin thin, entire, concolorous; context duplex, fibrous next to the hymenium, soft and floccose above, concolorous with the surface, 0.5–2.5 cm. thick, hyphae of the context branched, undulating, hyaline, 4–7 μ in diameter; tubes 3–12 mm. long, often collapsed in dried specimens; mouths white to Orange-Buff, at first round, later angular or daedaloid, 1–3 per mm.; dissepiments becoming lacerate with age, 120–200 μ thick; hymenium 20–30 μ thick, closely compact; basidia 4–7 μ broad; spores ovoid, sometimes apiculate, smooth, hyaline, 6–8 x 4–5 μ; cystidia abundant or rare, projecting or entirely buried in the hymenium, ventricose, 25–35 x 8–15 μ.

Habitat: on conifers.

Distribution: foothill and montane zones. Eastern and central United States.

Occurrence: rare.

Type of rot: white rot.

Polyporus borealis is of rare occurrence in Colorado as well as throughout the United States. Overholts collected it at Tolland, Colorado, and Bethel made a fine collection in Boulder Canyon, near Boulder, Colorado.

The ventricose cystidia distinctly mark this plant. These cystidia, however, are rarely found in great abundance; and when present, they are often partially or wholly buried in the hymenium.

3. Setae present, often rare or absent; no hyphal pegs or cystidia.

13. Polyporus Rheades (Pers.) Fries, Hym. Eur. p. 551. 1874.

Boletus Rheades Pers. Myc. Eur. **2**: 69. 1825.

Polyporus dryophilus Berk. Lond. Jour. Bot. **6**: 321. 1847.

Polyporus corruscans Fries in Vet. Akad. Forhandl. p. 52. 1851.

Inonotus dryophilus (Berk.) Murr. Bull. Torr. Bot. Club **31**: 597. 1904.

Plate 21, figs. 5–6.

Sporophores thick, subglobose or ungulate, often imbricate, 2–12 x 3–20 x 1.5–10 cm.; surface brown or reddish-brown, as Mahogany Red to Chestnut in the Colorado specimens growing on *Populus* spp., at first fibrillose, then scabrous, finally almost glabrous, zonate or azonate; margin thick, usually obtuse, sterile below; context 1–9 cm. thick, Chestnut-Brown in Colorado plants, zonate, soft when fresh, drying hard and fragile, containing a large central globose granular core which is permeated with white mycelial strands, hyphae of the context dark brown under the microscope, sparingly branched, 4–6 μ in diameter; tubes 2–20 mm. long, concolorous with the context; mouths angular and unequal, averaging 2 per mm., usually concolorous with the context; dissepiments becoming slightly lacerate, 50–120 μ thick; hymenium 9–12 μ thick, hyaline to yellowish or brownish, loosely arranged; basidia 5–8 μ broad, hyaline or yellowish; spores smooth, brownish, ovoid to subglobose, 5–7 x 4.5–5 μ; setae rare or absent (not observed in the Colorado collection), brown, sharply pointed, projecting up to 20 μ.

Habitat: various living and dead deciduous trees, especially species of *Quercus* and *Populus*.

Distribution: montane zone. Widespread in the United States.
Occurrence: rare.
Type of rot: brown heart-rot.

The only known record of the occurrence of this fungus in Colorado is a collection made by E. Smith at Estes Park, Colorado, on *Populus tremuloides*. On aspen, the fungus is imbricate, smaller, and of a darker reddish-brown color than when found growing on species of *Quercus*. Furthermore, the aspen form is not usually zonate. The Colorado collection agrees well with Lloyd's illustration.[47]

The hard central globose core, which is usually interwoven with white mycelial strands and is of a more granular consistency than the rest of the context, distinctly marks this species.

4. No hyphal pegs, cystidia, or setae present in the hymenium.

A. Spores allantoid, 2 μ or less in thickness.

14. Polyporus caesius (Schrad.) Fries, Syst. Myc. **1**: 360. 1821.
Boletus caesius Schrad. Spic. Fl. Germ. p. 167. 1794.
Boletus albidus Sow. Col. Figs. Eng. Fung. *pl. 226*. 1799.
Tyromyces caesius (Schrad.) Murr. N. Am. Fl. **9**: 34. 1907.

Plate 28, fig. 3.

Pileus sessile, rarely effused-reflexed, dimidiate, soft and spongy, fresh plants turn blue where touched or bruised, 1–5 x 1–6 x 0.5–2 cm.; surface sodden, tomentose to villous, azonate, white, Mineral Gray to Light Buff; context white, friable and soft, 3–15 mm. thick, hyphae of the context sparingly branched, 5–7 μ in diameter; tubes 2–9 mm. long, collapsing on drying; mouths white, Mineral Gray to Pinkish-Buff, angular, 3–4 per mm.; dissepiments 40–80 μ thick, lacerate with age; hymenium hyaline, 12–15 μ thick; basidia 4–6 μ broad; spores oblong-allantoid, hyaline, 3–5 x 1–1.5 μ; cystidia none.

Habitat: on both deciduous and coniferous hosts.
Distribution: montane zone. Widespread in the United States.
Occurrence: rare.
Type of rot: white rot.

Polyporus caesius is of common occurrence in many parts of

[47] Lloyd, C. G. Mycological Writings **5**: 755. *f. 1129*. 1916.

the United States, but in the Rocky Mountains it is extremely rare. The only known Colorado collection was made by Kauffman at Tolland, Colorado, on well-rotted coniferous logs. This species is the only soft, white-colored polypore that turns blue when touched or bruised.

15. Polyporus resinosus (Schrad.) Fries, Syst. Myc. **1**: 361. 1821. Not *P. resinosus* Rostk. 1838.

Boletus fuliginosus Scop. Fl. Carn. ed. 2. **2**: 470. 1772.
Boletus resinosus Schrad. Spic. Fl. Germ. p. 171. 1794.
Boletus benzoinus Wahlenb. Fl. Suec. **2**: 1076. 1826.
Polyporus benzoinus (Wahlenb.) Fries, Elench. Fung. p. 100. 1828.
Polyporus fuliginosus (Scop.) Fries, Epicr. Myc. p. 451. 1838.
Trametes benzoina (Wahlenb.) Fries, *ibid.* p. 489.
Ischnoderma resinosum (Schrad.) Karst. Medd. Soc. Faun. Fl. Fenn. **5**: 38. 1879.
Fomes fuliginosus (Scop.) Sacc. Syll. Fung. **6**: 164. 1888.
Ungulina fuliginosa (Scop.) Pat. Ess. Tax. Hymen. p. 103. 1900.
Ischnoderma fuliginosum (Scop.) Murr. Bull. Torr. Bot. Club **31**: 606. 1904.

Plate 22, fig. 2.

Pileus fleshy when fresh and with an anise-like odor, drying rigid, imbricate, sessile, effused-reflexed or entirely resupinate, applanate or dimidiate, sometimes affluent, 5–15 x 6–30 x 0.5–2.5 cm.; surface becoming pelliculose, rugose, zonate in mature plants, drying Snuff Brown, Prout's Brown to Bister, some zones blackish; context fleshy in fresh plants, drying firm and fragile, 3–15 mm. thick, Light Ochraceous-Buff to Tawny-Olive, hyphae of the context yellowish-brown under the microscope, sparingly branched, undulating, thick-walled, 5–7 μ in diameter; tubes 1–8 mm. long; mouths Light Buff to Cinnamon-Buff, darker (Sayal Brown to Warm Sepia) when bruised and on drying, round to angular, averaging 4–6 per mm.; dissepiments yellowish-brown under the microscope, 60–160 μ thick; hymenium usually loosely arranged, apparently absent in old specimens; basidia hyaline, 3–5 μ in

diameter; spores smooth, hyaline, allantoid, 5–7 x 1–2 μ; no cystidia or setae.

Habitat: various deciduous and coniferous hosts.

Occurrence: rare. Autumn.

Distribution: montane zone. Widespread in the United States.

Type of rot: white rot.

In the old sense, *Polyporus resinosus* grows only upon deciduous hosts, whereas *P. benzoinus*, which is evidently the same plant, grows only upon coniferous hosts. Snell *et al*[48] have pointed out that the cultural characteristics for the two plants mentioned above are quite similar. For the present, these two species are considered as conspecific.

B. Spores elongate-ellipsoid to cylindric, rarely allantoid, 1.5–3.5 μ in thickness.

16. Polyporus adustus (Willd.) Fries, Syst. Myc. **1**: 363. 1821.

Boletus adustus Willd. Fl. Berol. p. 392. 1787.

Boletus fuscoporus Planer, Ind. Pl. Erf. p. 26. 1788.

Boletus suberosus flabelliformis Batsch, Elench. Fung. Contin. **2**: 117. *pl. 226*. 1789.

Boletus pelleporus Bull. Herb. Fr. *pl. 501, f. 2*. 1790.

Boletus carpineus Sow. Col. Figs. Eng. Fung. *pl. 231*. 1799.

Polyporus pallescens Fries, Syst. Myc. **1**: 369. 1821.

Boletus isabellinus Schw. Schr. Nat. Ges. Leipzig **1**: 96. 1822.

Polyporus subcinereus Berk. Ann. & Mag. Nat. Hist. **3**: 391. 1839.

Bjerkandera adusta (Willd.) Karst. Medd. Soc. Faun. Fl. Fenn. **5**: 38. 1879. In part.

Myriadoporus adustus (Willd.) Peck, Bull. Torr. Bot. Club **11**: 27. 1884.

Plate 21, figs. 1–4.

Pilei fleshy-tough, drying brittle, conchate, sessile or effused-reflexed, imbricate, sometimes confluent, 1–5 x 2–10 x 0.1–0.8 cm.; surface sometimes undulate, indistinctly zonate or azonate, tomentose, white, Pink Buff, Warm Buff, Light Pinkish Cinna-

[48] Snell, W. H., W. G. Hutchinson, and K. H. N. Newton, Mycologia **20**: 279–280. 1928.

mon to Pale Smoke Gray; margin thin, acute, even to undulate, sterile below, often blackish in dried plants; context corky, white to Light Buff, 1–7 mm. thick, hyphae radially arranged, hyaline, rarely branched, thick-walled, 5–7 μ in diameter; tubes 0.5–4 mm. long; mouths various shades of smoke-color to black, very small, 4–6 per mm., round to angular, in dried plants the tubes sometimes become tufted; dissepiments thin, 50–100 μ; trama brownish under the microscope; hymenium hyaline, 7–9 μ thick; basidia 4-spored, 4–5 μ broad; spores hyaline, smooth, oblong to elongate-ellipsoid, rarely allantoid, 3–5 x 1.5–2.5 μ; cystidia none.

Habitat: deciduous hosts, especially species of *Populus;* rare on conifers.

Distribution: from the plains zone up to the subalpine zone. Widespread in the United States.

Occurrence: very common. Spring and summer.

Type of rot: spongy white rot.

Polyporus adustus is very commonly found on cottonwood (*Populus* spp.) stumps and logs on the plains and in the foothills; higher up, it is found on *Populus tremuloides.* Overholts collected this species of fungus on pine at Tolland, Colorado.

Three species of pore fungi having smoke-colored hymenia occur in the state of Colorado: *Polyporus adustus, P. crispus,* and occasionally *P. hirsutus.* In the latter species, the hymenium is white or very light smoke-colored and it never turns blackish as in the two former species. *Polyporus adustus* and *P. crispus* are more difficult to separate. The latter species is usually larger and the pileus is covered with radially adpressed, long, stiff fibrils; also, the latter species occurs more densely imbricated and the margin of the pileus is more crisped and wavy than in the former.

17. Polyporus crispus (Pers.) Fries, Obs. Myc. **1:** 127. 1815; Syst. Myc. **1:** 363. 1821.

Boletus adustus crispus Pers. Obs. Myc. **2:** 8. 1799.

Boletus crispus Pers. Syn. Fung. **2:** 529. 1801.

Bjerkandera adusta (Willd.) Karst. Medd. Soc. Faun. Fl. Fenn. **5:** 38. 1879. In part.

Plate 23, fig. 1.

Pilei fleshy-tough, drying brittle, conchate, sessile or effused-reflexed, densely imbricate, 1–8 x 3–10 x 0.1–0.5 cm.; surface undulate, zonate or azonate, radially adpressed-fibrillose, usually strigose at the base, color-range from Light Buff to Clay Color; margin thin, acute, crisped or wavy, frequently blackish, sterile below; context corky, white to Light Buff, 1–4 mm. thick, hyphae radially arranged, hyaline, rarely branched, thick-walled, 5–7 μ in diameter; tubes 0.5–4 mm. long; mouths various shades of smoke-color to black, very small, 4–6 per mm., round; dissepiments 90–120 μ thick; trama brownish under the microscope; hymenium hyaline, 7–9 μ thick; basidia 4-spored, 4–5 μ broad; spores hyaline, smooth, oblong to elongate-ellipsoid, rarely allantoid, 3–5 x 1.5–2.5 μ; cystidia none.

Habitat: on *Populus tremuloides* and probably other deciduous hosts; reported on pine.

Distribution: foothill and subalpine zones. Widespread in the United States.

Occurrence: rare.

Type of rot: spongy white rot.

Polyporus crispus is very closely related to *P. adustus*. The former differs from the latter chiefly in the radially adpressed fibrils on the surface of the pileus, more dense imbrication, and more wavy margin.

18. Polyporus fragilis Fries, Elench. Fung. p. 86. 1828.
Spongipellis fragilis (Fr.) Murr. Southern Polyp. p. 61. 1915.

Plate 24, fig. 4.

Pileus fleshy, becoming hard and fragile when dry, sessile or effused-reflexed, plano-depressed, reniform, dimidiate, sometimes attenuated behind into a stem-like base, and pendulous, imbricate, 3–7 x 3–7 x 0.5–1 cm.; surface azonate, or in mature plants indistinctly zonate, villose, rugose, whitish, becoming brown-spotted where touched, drying Hazel, Chestnut, to Chestnut-Brown; margin thin, fragile, concolorous; context 2–10 mm. thick, radially fibroid, drying hard and fragile, Pinkish Buff to Ochraceous-Tawny, hyphae of the context yellow under the microscope, nodose-septate, branched, of various diameters, 3–8 μ; tubes 2–8

mm. long, whitish, becoming Pinkish Buff, Carob Brown to Russet on drying; mouths whitish, becoming brown-spotted where touched, drying concolorous with the tubes, round or angular, becoming sinuous and labyrinthiform, 3–4 per mm.; dissepiments 75–100 μ thick, occasionally containing diamond-shaped crystalline bodies, 20 x 15 μ; hymenium hyaline, 10–12 μ thick; basidia hyaline, 9–10 x 5 μ, 4-spored; spores smooth, hyaline, cylindric, occasionally allantoid, 4–6 x 1.5–2 μ; no cystidia observed.

Habitat: on coniferous hosts.

Distribution: montane and subalpine zones. Widespread in the United States throughout the coniferous regions.

Occurrence: rare.

Type of rot: brown rot.

Fresh and young specimens of *Polyporus ursinus*, *P. fragilis*, and *P. mollis* all become brown-spotted where bruised or touched and some care must be exercised in separating these species. The latter species, however, has not as yet been reported from Colorado; *P. ursinus* can be separated on the presence of incrusted cystidia in its hymenium.

Polyporus fragilis is rare throughout the world, and only three collections have been reported from Colorado. The above description has been drawn from a collection made by Kauffman at Tolland, Colorado, in 1920.

19. Polyporus cinnabarinus (Jacq.) Fries, Syst. Myc. 1: 371. 1821.

Boletus cinnabarinus Jacq. Fl. Austr. 4: 2. 1776.

Boletus coccineus Bull. Herb. Fr. p. 364. 1791.

Trametes cinnabarina (Jacq.) Fries, Nov. Symb. p. 98. 1851.

Polystictus cinnabarinus (Jacq.) Sacc. Syll. Fung. 6: 245. 1888.

Pycnoporus cinnabarinus (Jacq.) Karst. Rev. Myc. 3⁹: 18. 1881.

Plate 24, fig. 1.

Pileus tough-leathery to rigid, sessile, dimidiate or flabelliform, 1–10 x 1–20 x 0.5–2 cm. (Colorado plants 1–5 x 1–5 x 0.5–1 cm.); surface azonate, rugulose, tomentose to glabrous, Etruscan Red,

Cinnamon-Rufus to Flame Scarlet, fading to Salmon Buff or white; margin thin and acute; context floccose, zonate, concolorous with the surface of the pileus, 1–15 mm. thick, hyphae of the context thick-walled, sparingly branched, yellowish under the microscope, 4–8 μ in diameter; tubes 1–5 mm. long; mouths circular to angular, 2–4 per mm., Brazil Red to Morocco Red; dissepiments yellowish under the microscope, 50–200 μ thick; hymenium yellowish to almost hyaline, 8–10 μ thick; basidia 6–7 μ broad; spores hyaline to yellowish, cylindric, rarely curved, smooth, 5–7 x 2–3 μ; cystidia none.

Habitat: on birch (*Betula* spp.), poplar (*Populus* spp.), and aspen (*Populus tremuloides*); rare on coniferous hosts.

Distribution: foothill zone. Widespread in the United States.

Occurrence: uncommon. Spring and summer.

Type of rot: white rot.

This fungus, although common in the eastern and central United States, has been collected only a few times in Colorado. Its color, however, is so obvious that the species may be recognized at once.

20. Polyporus anceps Peck, Bull. Torr. Bot. Club **22**: 207. 1895.

Tyromyces Ellisianus Murr. N. Am. Fl. **9**: 34. 1907.

Tyromyces anceps (Pk.) Murr. *ibid.* 35.

Polyporus Ellisianus (Murr.) Sacc. & Trott. in Sacc. Syll. Fung. **21**: 281. 1912.

Plate 23, fig. 2.

Pileus effused-reflexed, reflexed portion narrow, dimidiate, imbricate, frequently entirely resupinate, laterally connate, subcorky, drying rigid, 0.5–3 x 2–10 x 0.3–1.5 cm.; surface azonate to indistinctly zonate, minutely downy to scabrous, sometimes rugosely pitted, whitish to cream-color, drying Cream-Buff, Warm Buff, to Pinkish Buff; margin abrupt, concolorous or slightly darker where bruised, even or undulating; context white, drying white to Light Buff, 2–6 mm. thick, composed of hyphal complexes in which the individual hyphae vary from 1 to 7 μ in diameter, smaller branches interwoven and occasionally incrusted with

yellow crystalline material that is partially soluble in KOH solution; tubes 3–10 mm. long, often oblique, white, Pinkish Buff to Warm Buff; mouths concolorous, darker where bruised, circular to angular, 3–5 per mm.; dissepiments 60–120 μ thick; hymenium hyaline, thin, 16–20 μ broad; basidia hyaline, 5–6 μ broad; spores hyaline, smooth, cylindric to elongate-ellipsoid, rarely curved, 7–9 x 3–3.5 μ; no cystidia.

Habitat: on various coniferous hosts.

Distribution: foothill zone. Coniferous regions of the United States except the far west.

Occurrence: very rare. Summer and autumn.

Type of rot: white pocket rot.

The one outstanding character of *Polyporus anceps* is the hyphal complex nature of the context. These complexes have thick central axes with thinner and tapered side-branches coming off in a dendroid fashion.

This species is apparently rare in the Rocky Mountain region, and at the present time only a single collection from Colorado has been recorded.

C. Spores ellipsoid to subglobose, 4–5 μ in thickness.

21. Polyporus planellus (Murr.) Overh. Wash. Univ. Studies **3**: 29. 1915.

Polyporus planus Peck, Ann. Rept. N. Y. State Mus. **31**: 37. 1879. Not *P. planus* Wallr. 1833.

Coriolus planellus Murr. Bull. Torr. Bot. Club **32**: 649. 1906.

Plate 22, fig. 1.

Pileus thin, coriaceous-rigid, dimidiate or flabelliform, sometimes narrowly attached, sessile, effused-reflexed or entirely resupinate, 1–3.5 x 1–4 x 0.05–0.2 cm.; surface tomentose when young, becoming glabrous, rugulose, multizonate with occasional intermixed dark or blackish zones, Auburn, Raw Umber, Chestnut-Brown, or lighter; margin very thin, undulating to lobed, usually lighter-colored to almost white, sterile below; context less than 1 mm. thick, Light Pinkish Cinnamon, hyphae of the context brownish under the microscope, branched, 3–4 μ in

diameter; tubes less than 1 mm. long; dissepiments entire, brownish under the microscope, 40–100 μ thick; mouths angular to daedaloid, 5–6 per mm., white, Vinaceous-Buff to Vinaceous-Pink; hymenium hyaline, 16–20 μ thick; basidia 6–8 μ broad, 4-spored; spores hyaline, smooth, ovoid to ellipsoid, 9–12 x 4 μ; no cystidia observed.

Habitat: various deciduous hosts.

Distribution: foothill and montane zones. Found throughout the northern part of the United States.

Occurrence: rare. Summer.

Type of rot: unknown.

This fungus differs from *Polyporus versicolor* in having a brownish-colored context and trama, in having larger and different shaped spores, and in the absence of hyphal pegs. *Polyporus planellus* is almost always resupinate; occasionally, the margin is narrowly reflexed, and rarely is it found to be sessile.

22. Polyporus spumeus (Sow.) Fries, Syst. Myc. **1**: 358. 1821.

Boletus spumeus Sow. Col. Figs. Eng. Fung. *pl. 211*. 1797.

Spongipellus spumeus (Sow.) Pat. Ess. Tax. Hymen. Eur. **1**: 140. 1887.

Spongipellus occidentalis Murr. N. Am. Fl. **9**: 38. 1907.

Plate 28, fig. 2.

Pileus soft and watery and with an anise-like odor when fresh, drying rigid, dimidiate, sessile, subimbricate, rarely attenuated towards the base into a stalk-like process, convex above, 5–20 x 6–20 x 2–6 cm., much thinner when dry; surface azonate, hirsute, fibrillose, or matted-strigose, white to yellowish, drying Light Ochraceous-Buff, Ochraceous-Buff to Ochraceous-Tawny; margin acute, undulating to lobed, concolorous; context in fresh plants white to yellowish, drying Cinnamon-Buff to Clay Color, indistinctly duplex, soft and cottony above, firm and fibrous next to the tubes, 1–3 cm. thick, hyphae of the context partially gelatinized, hyaline, branched, 3–6 μ in diameter; tubes concolorous with the context, distinct from the context but not separable, 0.5–3 cm. long, when dry often collapsed; mouths angular, con-

colorous or drying as dark as Hazel, 2–4 per mm.; dissepiments with age becoming dentate-lacerate, 60–120 μ broad; hymenium hyaline, 18–22 μ broad; basidia hyaline, 5–7 μ in diameter; spores hyaline, smooth, ellipsoid to subglobose, apiculate, 5–7 x 4–5 μ; no cystidia.

Habitat: cottonwoods (*Populus* spp.) and other deciduous hosts.

Distribution: plains zone. Northern United States.

Occurrence: rare. Summer.

Type of rot: white rot (?).

The only known collection of this fungus from Colorado was made by Bethel, at Denver, Colorado, on cottonwood. The anise-like odor of the fresh plant is a noteworthy characteristic.

The original illustration of this species by Sowerby (*l. c.*) shows the plant to be substipitate, a condition that apparently is not common, and which has led to considerable confusion. The description as given above defines the plant as it is known in America.

Section II. Sporophores centrally, excentrically, or laterally stipitate; all gymnocarpous.

1. Hyphal pegs present; cystidia and setae absent.

23. Polyporus arcularius (Batsch) Fries, Syst. Myc. **1**: 342. 1821.

Boletus arcularius Batsch, Elench. Fung. p. 97. 1783.

Not *B. arcularius* Schw. 1822.

Polyporus arculariformis Murr. Torreya **4**: 151. 1904.

Plate 24, figs. 5–6.

Pileus circular, convex to umbilicate, 1–8 cm. in diameter, 1–4 mm. thick; surface azonate, depressed center, squamulose, hispid-tomentose or glabrous, Cinnamon-Buff to Antimony Yellow when fresh, drying Buckthorn Brown to Pecan Brown; margin acute, ciliate, straight, reflexed on drying; context white, drying white to Pinkish Buff, 0.5–2 mm. thick, hyphae of the context hyaline under the microscope, branched, 2–5 μ in diameter; tubes decurrent, white to Pinkish Buff, drying Light Pinkish Buff to Tawny, 1–3 mm. long; mouths large, angular, concolorous with

the tubes, about 1 mm. broad; stipe central, slender, 2–4 cm. long, 2–3 mm. thick, squamulose, hispid-tomentose or glabrous above, fibrillose and bulbous at the base, concolorous with the pileus or slightly darker; dissepiments hyaline under the microscope, 150–250 μ broad, tapered towards the mouths to an acute edge, edges slightly denticulate; hymenium hyaline, closely compact, 16–20 μ broad; basidia 5–7 μ broad; spores hyaline, smooth, elongate-ellipsoid, apiculate, 7–9 x 2–3 μ; hyphal pegs present, usually incrusted, hyphae scarcely discernible, projecting up to 60 μ and 15–20(45) μ in diameter.

Habitat: on various deciduous hosts, especially *Populus tremuloides*.

Distribution: montane zone. Widespread in the United States.

Occurrence: uncommon. Spring and early summer.

Type of rot: white rot.

Polyporus arcularius is characterized by its honey-colored pileus, its ciliate margin, and its large angular pores. *Favolus alveolaris* likewise has large angular pores, but lacks the ciliated margin of the pileus.

2. Cystidia present, rare or at times absent; no hyphal pegs or setae.

24. Polyporus Schweinitzii Fries, Syst. Myc. **1:** 351. 1821.

Boletus sistotremoides Alb. & Schw. Consp. Fung. p. 243. 1805.

Daedalea epigaea Lenz, Schwämme, p. 62. 1831.

Polyporus tabulaeformis Berk. Lond. Jour. Bot. **4:** 302. 1845.

Polyporus spectabilis Fries, Nov. Symb. p. 48. 1851.

Polyporus hispidoides Peck, Ann. Rept. N. Y. State Mus. **33:** 21. 1880.

Polystictus Schweinitzii (Fr.) Karst. Rev. Myc. **3⁹:** 18. 1881.

Cladomeris Schweinitzii (Fr.) Quél. Ench. Fung. p. 169. 1886.

Phaeolis sistotremoides (Alb. & Schw.) Murr. Bull. Torr. Bot. Club **32:** 363. 1905.

Plate 25, figs. 1–2.

Pileus stipitate, occasionally sessile, convex, umbonate to infundibuliform, spongy and of light weight, variously shaped from

dimidiate to circular, 5–20–50 cm. or more broad, 0.5–2(4) cm. thick; surface azonate to zonate, strigose-tomentose, even, pitted, rugulose or nodulose, Kaiser Brown, Auburn, Bay, or black; margin concolorous or Yellow Ocher, often finely velvety-tomentose, inflexed when dry, sterile below; context soft and spongy, drying fragile-friable, zonate, 0.2–3(6) cm. thick, Raw Sienna, Argus Brown to Chestnut-Brown, hyphae of the context dark-brown under the microscope, often collapsed, branched, 6–12 μ in diameter; tubes decurrent, 2–8 mm. long, Light Orange-Yellow, changing color with age and becoming concolorous with the surface; mouths concolorous with the tubes, irregular and of unequal size, about 1 mm. broad; dissepiments 120–150 μ thick, dentate with age, occasionally breaking down, resulting in pores of extra large size; trama concolorous with the context; stipe central, excentric, lateral or wanting, when present 1–6 cm. long, 1–4 cm. thick, of the same color and structure as the pileus; hymenium yellow, compact, 16–22 μ broad; basidia yellow, 4-spored, 6–8 μ in diameter; spores hyaline, smooth, ovoid-ellipsoid, 6–8 x 4–5 μ; cystidia occasional, rare, or entirely absent, long-cylindric or clavate, yellowish-brown, 8–10 μ broad, projecting up to 60 μ.

Habitat: living or dead conifers; ground near conifers, but apparently attached to their roots. Rare on deciduous trees.

Distribution: throughout the coniferous regions of Colorado and the United States.

Occurrence: uncommon. Summer and autumn.

Type of rot: brown rot.

This fungus is of outstanding economic importance in causing the decay of both living and dead coniferous trees. The sporophores are usually found growing from the buried and above-ground parts of roots; occasionally they are attached to the trunk of the tree, and in this case the fruiting bodies are often sessile. Of the synonyms, *Polyporus tabulaeformis* and *P. hispidoides* refer to the sessile form of growth.

Sections through the pores of this fungus, when examined under the microscope, show a dark-brown trama and a yellowish hymenium. The hymenium likewise appears yellow to yellowish-red to the unaided eye. In old and weathered plants, however, the hymenium becomes concolorous with the trama, and hence

this color-differentiation loses its significance. An orange-yellow alcohol- and water-soluble pigment is present in this fungus.

3. Setae present and abundant; no hyphal pegs or cystidia.

25. Polyporus circinatus Fries, Monogr. Hymen. Suec. **2**: 268. 1863.

Polyporus dualis Peck, Ann. Rept. N. Y. State Mus. **30**: 44. 1878.

Coltricia tomentosa (Fr.) Murr. Bull. Torr. Bot. Club **31**: 346. 1904; *Polyporus tomentosus* sensu Murrill.

Polyporus Peakensis Lloyd, Mycol. Notes **6**: 933. 1920.

Plate 26, figs. 1–2.

Pileus circular to flabelliform, convex, plane or depressed at the center, 3–20 cm. in diameter, 3–20 mm. thick, solitary or caespitose, rarely confluent; surface azonate or indistinctly zonate, velvety-tomentose, Mars Yellow to Ochraceous-Tawny; margin acute, usually sterile below, entire or lobed, of a lighter color as: Pale Orange to Warm Buff; context 1–15 mm. thick, duplex, upper part soft-corky, homogeneous and concolorous with the surface, lower part woody, homogeneous or indistinctly multizonate, usually of a lighter color as: Light Orange-Yellow to Ochraceous Buff, hyphae of the two regions of the context apparently similar under the microscope, brownish, undulating, sparingly branched, 5–7 μ in diameter; tubes short-decurrent, 1–5 mm. long, Cinnamon-Buff to Clay Color, usually whitish within; mouths angular, irregular, unequal, 2–3 per mm., concolorous with the tubes or Light Buff; dissepiments becoming dentate with age, tomentose-hairy at the mouths, 120–150 μ thick; stipe central, excentric or lateral, sometimes lacking, unequal, usually obese, of the same structure and color as the pileus, up to 5 cm. long, 0.5–3 cm. thick; hymenium hyaline, 16–20 μ broad; basidia hyaline, small, 4–5 μ broad; spores smooth, hyaline under the microscope, cylindric-ovoid, 4–6 x 3–4 μ; setae pointed, often incrusted and the incrustation soluble in KOH solution, projecting up to 50 μ, 8–12 μ broad at their bases.

Habitat: on the ground in coniferous forests and apparently

attached to buried wood, rarely found in deciduous forests or growing directly attached to wood.

Distribution: montane and subalpine zones. Widespread in the United States.

Occurrence: frequent. Summer and autumn.

Type of rot: white rot.

Polyporus circinatus is most frequently found growing in troops on the ground in coniferous forests. The finer hyphae may be traced to buried wood or roots where it produces a white pocket rot. The soft, brown pileus and the duplex context distinctly separate this fungus from all other stipitate polypores known to occur in Colorado.

Some authors consider *Polyporus tomentosus* Fr. and *P. circinatus* to be synonymous. Lloyd,[49] however, points out that the former has a homogeneous context and is thus distinct. Furthermore, he is of the opinion that it does not occur in the United States. Undoubtedly, all American plants so named belong to *Polyporus circinatus*.

Polyporus Peakensis, which was described by Lloyd from a single specimen collected by Hedgcock, near Moraine Lake, Pikes Peak, Colorado, is conspecific.

Hubert,[50] reports this fungus to be parasitic on pine.

4. No hyphal pegs, cystidia, or setae in the hymenium.

A. Spores ovoid to subglobose, 3–5 x 2–4 μ.

26. Polyporus ovinus (Schaeff.) Fries, Syst. Myc. **1:** 346. 1821.
Boletus ovinus Schaeff. Icon. Fung. **2:** *pl. 121, 122.* 1780.
Scutiger ovinus (Schaeff.) Murr. Mycologia **12:** 20. 1920.

Plate 24, fig. 2.

Pilei fleshy, gregarious or solitary, circular, convex, 4–14 cm. in diameter, 3–10 mm. thick; surface at first tomentose, white or tan-colored, with age becoming areolate, subsquamulose, or more rarely subpelliculose, drying Avellaneous to Fawn Color and black-spotted; margin acute, even or undulating, concolorous or

[49] Lloyd, C. G. Synopsis of the stipitate Polyporoids. pp. 159–160. Cincinnati, 1912.

[50] Hubert, E. E. Phytopath. 19: 745–747. 1929.

blackish, inflexed on drying, sterile below; context at first white, drying Light Pinkish Cinnamon, usually containing a black line adjacent to the tubes, 1–6 mm. thick, hyphae of the context slightly colored under the microscope, walls partially gelatinized, branched, of markedly unequal diameters, varying from 4 up to 25 μ; tubes decurrent, at first whitish, drying Clay Color, Tawny to Chestnut-Brown, 1–3 mm. long; mouths angular, concolorous with the tubes, 2–3 per mm.; dissepiments with age becoming dentate, 20–80 μ broad; trama slightly colored under the microscope; stipe central, solid, usually with a bulbous base, tomentose, at first whitish to tan-colored, drying Light Vinaceous-Cinnamon to Clay Color, often black-spotted, bulbous base Apricot Buff, 2–7 cm. long, 1–2 cm. thick; hymenium hyaline, 12–18 μ broad; basidia hyaline, very small, 3–4 μ in diameter; spores hyaline, smooth, subglobose, 3.5–4.5 x 2.5–3 μ; no cystidia.

Habitat: on the ground in coniferous forests.

Distribution: montane zone. Northern United States.

Occurrence: rare.

Polyporus ovinus is rare in the United States, and is known from Colorado only from the collections of F. E. and E. S. Clements distributed in their "*Cryptogamae Formationum Coloradensium*" *no. 338*, as *Polyporus subsquamosus*.

In dried plants, the pileus and stipe of this fungus appear "scorched" or blackish-spotted, and the base of the stipe is frequently pinkish, but never as pink as in dried plants of *Polyporus confluens*. The black line at the base of the tubes appears to be a fairly constant character. Additional characters of this species are the small spores and the partially gelatinized hyphae of the context which are of varying diameters.

In Europe, the pileus of this plant may be decidedly squamulose, as is shown in Schaeffer's 'Icones' plate 122, and by *no. 1423* of Sydow's 'Mycotheca Germanica.' The American plants, however, are most like those illustrated by Schaeffer in his plate 121, but at times a more areolated or subsquamose condition of the surface of the pileus may be encountered.

27. Polyporus confluens (Alb. & Schw.) Fries, Syst. Myc. **1**: 355. 1821.

Boletus confluens Alb. & Schw. Consp. Fung. p. 244. 1805. Not *B. confluens* Schum. 1803.
Scutiger laeticolor Murr. Bull. Torr. Bot. Club **30**: 428. 1903.
Scutiger Whiteae Murr. *ibid.* 432.

Plate 28, fig. 1.

Pilei solitary or gregarious, confluent, circular or irregular, convex or umbilicate, 5–16 cm. in diameter, 1–3 cm. thick; surface glabrous, pelliculose, with age becoming rimose, areolate or scaly, when fresh Ivory-White, Buff-Pink, Cinnamon-Buff to Clay-Color, drying Cinnamon-Buff to Mikado Brown; margin entire to lobed, thin, incurved, concolorous; context 1–2.5 cm. thick, white, soft when fresh, drying Cinnamon-Buff to Buff-Pink, usually containing a thin reddish-orange stratum adjacent to the tubes, hyphae of the context hyaline, gelatinized and not easily discernible, branched, densely interwoven, of various thicknesses, 2–10 μ in diameter; tubes 1–2 mm. long, subdecurrent to long-decurrent, often oblique, white to Cream Color when fresh, changing on drying to Flame Scarlet, Cinnamon-Buff or Buff-Pink; mouths concolorous with the tubes, frequently stuffed, angular, 2–3 per mm.; dissepiments at first thick, with age becoming thin and denticulate, occasionally breaking down, resulting in pores of extra large size; hyphae of the trama gelatinized as in the context; stipe simple, branched or confluent, 3–10 cm. long, 0.5–2 cm. thick, concentric to excentric, round or compressed, solid and homogeneous, usually pointed at the base, concolorous with the pileus; hymenium 16–20 μ broad; basidia 4-spored, 5–6 μ in diameter; spores hyaline, smooth, ovoid to subglobose, apiculate, 4–5 x 3–4 μ; no cystidia.

Habitat: on the ground in coniferous forests.

Distribution: montane and subalpine zones. Northeastern United States.

Occurrence: uncommon. Autumn.

Polyporus confluens, as the specific name implies, is frequently found with both the pilei and the stipes confluent; however, single and well-formed specimens that are not confluent may be found. In fresh plants, the context and the tubes are whitish, but on bruising and on drying they turn pink. In many dried

plants, the tubes and a narrow stratum of the adjacent context are reddish-colored.

Kauffman[51] has fully discussed and well illustrated his Colorado collections of this species.

B. Spores elongate-ellipsoid.

a. Spores 7–9 x 4–5 μ.

28. Polyporus perennis (L.) Fries, Syst. Myc. **1**: 350. 1821.
Boletus perennis L. Sp. Pl. p. 1177. 1753.
Boletus coriaceus Scop. Fl. Carn. ed. 2. **2**: 465. 1772.
Boletus subtomentosus Bolt. Hist. Fung. **2**: 87. *pl. 87.* 1788.
Boletus confluens Schum. Enum. Pl. Saell. **2**: 378. 1803.
Not *B. confluens* Alb. & Schw. 1805.
Coltricia connata S. F. Gray, Nat. Arr. Brit. Pl. **1**: 644. 1821.
Polystictus perennis (L.) Karst. Rev. Myc. **3**[9]: 18. 1881.
Pelloporus perennis (L.) Quél. Ench. Fung. p. 166. 1886.
Coltricia perennis (L.) Murr. Jour. Myc. **9**: 91. 1903.

Plate 26, fig. 3.

Pilei gregarious, sometimes confluent, coriaceous, thin, circular, convex or umbilicate, 1–6 cm. in diameter, 1–6 mm. thick; surface zonate, tomentose, substriate, the zones sometimes glabrous, Sudan Brown to Hazel, rarely paler and cinereous as Tilleul-Buff; margin thin, acute, even, undulating to lobed, sometimes fimbriate from the extended tomentum, occasionally sterile below; context less than 1 mm. thick, concolorous with the surface, hyphae of the context reddish-brown under the microscope, sometimes collapsed, branched, 6–8 μ in diameter; tubes adnate to decurrent, 1–4 mm. long, grayish within; mouths angular, 2–3 per mm., Ochraceous-Tawny, Sayal Brown to Cinnamon Brown; stipe central, velvety, usually concolorous with the pileus, sometimes broadly attached, occasionally flat and branched, more frequently round and unbranched, solid, rarely stuffed, often bulbous at the base, 2–5 cm. long, 1–10 mm. thick; dissepiments denticulate, 100–150 μ broad, tapered towards the mouths; trama concolorous with the context; hymenium loosely arranged,

[51] Kauffman, C. H. Mich. Acad. Sci. Arts & Lett., Papers **1**: 119–122. *pl. 34.* 1921.

yellowish-brown or hyaline under the microscope, 20–25 μ thick; basidia yellowish-brown or hyaline, 7–9 μ broad; spores yellowish-brown, smooth, elongate-ellipsoid, 7–9 x 5 μ; no cystidia or setae observed.

Habitat: ground-inhabiting, especially in burned-over regions, rare on coniferous wood.

Distribution: montane and subalpine zones. Widespread in the United States.

Occurrence: frequent. Throughout the season.

This ground-inhabiting fungus is most frequently found in regions where the trees have been destroyed by fires. The pilei often become confluent when the fruiting-bodies grow close together. Sticks, grass, and other forest-floor debris occasionally become imbedded in the fruiting-bodies. Infrequently, the pileus is covered with a cinereous pubescence which is in marked contrast to its usual dull-brownish color.

Polyporus perennis is related to *P. cinnamomeus*, both of which have similar hymenial characteristics. Sporophores of the former species are larger in size, and the surface of their pilei are of a dull brownish color, whereas the latter fungus is marked by its smaller size and its silky, shining, reddish-brown surface.

29. Polyporus cinnamomeus (Jacq.) Fries, Epicr. Myc. p. 429. 1838.

Boletus cinnamomeus Jacq. Coll. 1: 116. 1786.

Strilia cinnamomea S. F. Gray, Nat. Arr. Brit. Pl. 1: 645. 1821.

Polyporus parvulus Klotzsch, Linnaea 8: 483. 1833. Not *P. parvulus* Schw. 1832.

Polyporus oblectans Berk. Lond. Jour. Bot. 4: 51. 1845.

Polyporus splendens Peck, Ann. Rept. N. Y. State Mus. 26: 68. 1874.

Polystictus cinnamomeus (Jacq.) Sacc. Michelia 1: 362. 1878.

Polyporus subsericeus Peck, Ann. Rept. N. Y. State Mus. 33: 37. 1880.

Coltricia cinnamomea (Jacq.) Murr. Bull. Torr. Bot. Club 31: 343. 1904.

Plate 24, fig. 3.

Pilei gregarious, confluent, thin, circular, convex or umbilicate, 1–4 cm. in diameter, 1–3 mm. thick; surface zonate, radially adpressed-tomentose to -fibrillose, shining, Kaiser Brown; margin thin, acute, undulating to slightly lobed, sometimes fimbriate from the extension of the tomentum, occasionally sterile below; context less than 1 mm. thick, concolorous with the surface, hyphae of the context reddish-brown under the microscope, sometimes collapsed, branched, 6–8 μ in diameter; tubes adnate to slightly decurrent, 1–2 mm. long, Testaceous to Ferruginous; mouths angular, 2–3 per mm., concolorous with the tubes; stipe central, velvety, concolorous with the pileus, sometimes broadly attached, flat and branching, solid, often bulbous at the base, 1–4 cm. long, 1–3 mm. thick; dissepiments denticulate, 100–150 μ broad, tapered towards the mouths; trama concolorous with the context; hymenium loosely arranged, yellowish-brown to hyaline, 20–25 μ thick; basidia yellowish-brown to hyaline, 7–9 μ broad; spores yellowish-brown, smooth, elongate-ellipsoid, 7–9 x 5 μ; no cystidia or setae.

Habitat: on the ground in coniferous forests and aspen groves.

Distribution: montane and subalpine zones. Of frequent occurrence in the eastern United States; rare in the West.

Occurrence: rare. Autumn.

This small and delicate plant usually occurs in dense clusters with confluent pilei. The outstanding characteristics which separate it from *Polyporus perennis* are the reddish-brown color and the silky nature of the pileus.

Kauffman (*l. c.*) reports frequent collections of this fungus from Leal and Tolland, Colorado, during the month of September, 1917, and again in 1920. No other collections are known from Colorado.

30. Polyporus cryptopus Ellis & Barth. Erythea **4**: 79. 1896.
Scutiger cryptopus (Ellis & Barth.) Murr. Bull. Torr. Bot. Club **30**: 428. 1903.

Plate 25, fig. 3.

Pileus circular, convex, 3–4(7) cm. in diameter, 3–4 mm. thick; surface finely tomentose, smooth, white or gray, drying

wrinkled, Avellaneous; margin very thin, inflexed when dry, concolorous, entire; context white, drying Pinkish Buff, homogeneous, 1–2 mm. thick, hyphae of the context partially gelatinized, hyaline, branched, interwoven, 3–4 μ in diameter; tubes whitish, drying Warm Buff to Cinnamon-Buff, 1–2 mm. long, decurrent; mouths angular, large, 1–2 per mm., concolorous with the tubes; dissepiments thin, 80–150 μ, dentate; stipe central, bulbous at the base, solid, tomentose, 1.5–2 cm. long, 4–10 mm. thick, upper part concolorous with the tubes, lower part as dark as Snuff Brown, stipe almost entirely subterranean; hymenium 12–15 μ broad; basidia 6–8 μ in diameter; spores hyaline, smooth, ellipsoid, apiculate, 7–8 x 4 μ; no cystidia.

Habitat: ground, sometimes attached to grass roots.

Distribution: plains zone. Western and central United States.

Occurrence: rare. Spring and early summer.

The only record of the occurrence of this fungus in Colorado is a single collection made by Bethel, at Boulder, Colorado, in a field near the Chautauqua grounds. It is evidently found only in the plains and is characterized by its buried stipe and its round, whitish, coin-like cap.

b. Spores 12–16 x 4–6 μ.

31. Polyporus squamosus (Huds.) Fries, Syst. Myc. **1**: 343. 1821.

Boletus squamosus Huds. Fl. Angel. ed. 2. p. 626. 1778.

Polyporus caudicinus Murr. Jour. Myc. **9**: 89. 1903.

Plate 29, figs. 1–2.

Pileus fleshy when fresh, drying hard and very brittle, solitary in Colorado, reported usually as imbricate, sub-circular when young but soon becoming flabelliform, 10–40(50) cm. in diameter, 0.5–4 cm. thick; surface smooth, Pinkish Buff to Cinnamon Buff when fresh, drying Cinnamon-Buff to Clay Color, clothed with large appressed or free Snuff Brown to Sepia scales; margin thin, involute, slightly wavy; context soft and white when fresh, drying corky-friable, Light Buff or lighter, homogeneous, 0.5–3.5 cm. thick, hyphae of the context hyaline, branched, undulating,

4–8 μ in diameter; tubes decurrent as very shallow pits or reticulate ridges, at first the tubes are only reticulations, later, they develop up to 8 mm. long, white to Light Buff, drying Cinnamon; mouths large, angular and irregular, alveolar, 1–4 mm. broad, concolorous with the tubes; dissepiments round and broad at their free ends, about 600 μ thick, often pulled apart in dried plants; stipe lateral or excentric, variable as to size and shape, frequently rudimentary, at first obese, reticulate-poroid above and concolorous with the tubes, blackish below and often areolate, solid, homogeneous; hymenium compact, 20–30 μ thick; basidia 8 μ broad; spores hyaline, smooth, elongate-ovoid to -ellipsoid, apiculate, 12–16 x 5–6 μ; no cystidia.

Habitat: on deciduous hosts, especially cottonwoods (*Populus* spp.)

Distribution: known only from the plains zone in Colorado. Northeastern United States.

Occurrence: uncommon. Spring.

Type of rot: white rot.

Polyporus squamosus is generally found growing from the base of cottonwood (*Populus* spp.) stumps. It makes its appearance very early in the spring and develops to its maximum size by the early part of May. Although this fungus is rare in the United States, in Europe it is reported as being a common species that attacks frondose trees, especially the ash. This species is well marked by its large size, scaly pileus, and black stem.

32. Polyporus hirtus Quél. Champ. Jura et Vosges. **2:** 356. *pl. 2, f. 7.* 1873.

Polyporus hispidellus Peck, Ann. Rept. N. Y. State Mus. **52:** 649. 1899.

Scutiger hispidellus (Pk.) Murr. West. Polyp. p. 16. 1915.

Plate 27, fig. 3.

Pilei usually solitary, fleshy-tough, circular or sub-circular, convex or depressed, 5–14 cm. in diameter, 1–2.5 cm. thick; surface azonate, fibrillose, smooth, areolate or squamulose with age, Seal Brown to Bone Brown, not usually changing color on drying (Colorado specimens), or else fading to Wood Brown;

margin wavy-lobed, concolorous; context soft, homogeneous, white, drying hard, white to Light Buff, 3–20 mm. thick, hyphae of the context hyaline, thick-walled, undulating and irregular, branched, nodose-septate, 6–12 μ in diameter; tubes decurrent, 3–10 mm. long, white, drying Light Buff to Buckthorn Brown, occasionally blackish where bruised; mouths angular and irregular, 1–2 per mm., concolorous with the tubes; dissepiments thin, 80–120 μ thick, dentate; stipe lateral or excentric, often irregular, 2–5 cm. long, 1–5 cm. thick, solid, homogeneous, tomentose, white to Pinkish Buff; hymenium 24 μ broad; basidia large and conspicuous, 4-spored, 8–10 μ broad; spores elongate-ellipsoid, 12–16 x 4–6 μ when mature, hyaline, smooth; no cystidia.

Habitat: on rotted coniferous wood and on the ground.

Distribution: montane and subalpine zones. Found in the northern half of the United States.

Occurrence: rare. Late summer and autumn.

Polyporus hirtus, although a rare plant in the United States, has been collected in Colorado by both Overholts and Kauffman, and twice by the writer. The fresh plants are well marked by their dark brownish-gray, or brownish-purple pilei, and their whitish pores and stipes. In dried plants, the surface of the pileus rarely changes color, but the pores and stipe become a light yellowish-brown. The surface of the pileus becomes scaly after prolonged weathering, especially during the late autumn.

C. Spores cylindric.

a. Spores 8–10 x 3–4 μ.

33. Polyporus varius (Pers.) Fries, Syst Myc. **1**: 352. 1821.
Boletus varius Pers. Syn. Fung. p. 523. 1801.
Boletus calceolus Bull. Champ. p. 338. *pl. 360, 445.* 1791.
Polyporus calceolus (Bull.) Murr. Bull. Torr. Bot. Club **31**: 41. 1904.

Plate 27, figs. 4–7.

Pileus circular, reniform to flabelliform, sometimes with a depressed center, convex or nearly plane, 2–10 cm. in diameter, 3–10 mm. thick; surface radially striate, adpressedly-tomentose to almost glabrous, Clay Color to Ochraceous-Buff, radially

splotched with Hay's Russet; margin thin, obtuse, becoming wavy to lobed with age, concolorous to darker, Hay's Russet, Liver Brown to black, frequently sterile below; context white to Warm Buff, homogeneous, corky, 1–7 mm. thick, hyphae of the context yellowish under the microscope, branched, undulating, thick-walled, 4–5 μ in diameter; tubes 1–4 mm. long, decurrent, Cinnamon to Cinnamon Brown; mouths small, round to angular, 4–5 per mm., concolorous with the tubes; stipe excentric or lateral, rarely central, woody, solid, 1–4 cm. long, 4–10 mm. thick, tomentose to glabrous, upper portion concolorous with the hymenium, lower portion abruptly black and laccate; dissepiments golden under the microscope, at first as thick as 300 μ, later thinner, 50–100 μ; hymenium hyaline, compact, present in young plants, apparently absent in older ones, 16–20 μ thick; basidia 7–8 μ in diameter; spores hyaline, smooth, cylindric, 8–10 (12) x 3–4 μ.

Habitat: on various deciduous hosts, especially *Populus tremuloides*.

Distribution: montane zone. Widespread in the United States.

Occurrence: common some years, rare or absent during others. Summer and autumn.

Type of rot: white rot.

Polyporus varius, *P. elegans*, and *P. picipes* represent three closely related species which vary from one another mainly in the size of their fructifications and the color of their pilei. So far as the writer is informed, *P. picipes* has never been collected in Colorado and it may not occur there. The surface of the pileus of *P. varius* is marked with radially striate, reddish-brown bands, whereas that of *P. elegans* is always tan-colored with none of the above markings.

34. Polyporus elegans (Bull.) Fries, Epicr. Myc. p. 440. 1838.
Boletus elegans Bull. Herb. Fr. *pl. 46*. 1780.
Boletus nummularis Bull. *ibid. pl. 124*. 1782.

Plate 27, figs. 1–2.

Pileus circular, reniform to flabelliform, sometimes with a depressed center, convex or nearly plane, 1–7 cm. in diameter, 2–8

mm. thick; surface azonate, occasionally very faintly radially striate but never markedly so, pruinose to glabrous, Light Ochraceous-Buff to Cinnamon, rarely fading out to white; margin thin, becoming wavy or much lobed with age, concolorous or darker as: Bay to Chestnut, in young plants frequently sterile below; context white to Warm Buff, homogeneous, corky, 1–5 mm. thick, hyphae of the context yellowish under the microscope, branched, undulating, thick-walled, 4–5 μ in diameter; tubes 1–3 mm. long, decurrent, Cinnamon to Cinnamon-Brown; mouths small, round to slightly angular, 4–5 per mm., concolorous with the tubes; stipe excentric or lateral, rarely central, woody, solid, 1–4 cm. long, 2–6 mm. thick, pruinose to glabrous, upper portion concolorous with the hymenium, lower portion abruptly black and laccate, scutate or rooting at the base; dissepiments golden under the microscope, at first as thick as 300 μ, later thinner, 50–100 μ; hymenium hyaline, compact, present in young specimens, apparently absent in old ones, 16–20 μ thick; basidia 7–8 μ in diameter; spores hyaline, smooth, cylindric, 8–10(12) x 3–4 μ.

Habitat: various deciduous hosts, especially *Populus tremuloides*.

Distribution: montane zone. Widespread in the United States.

Occurrence: common some years, rare or absent during others. Summer and autumn.

Type of rot: white rot.

Polyporus elegans is closely related to *P. varius* and some care must be exercised in separating them (see p. 359). This fungus evidently persists for several years, during which time it remains attached to its substratum. Under long exposure to the elements, it often becomes bleached to a dirty white, and the tubes are very much disorganized and cracked as shown in plate 27, fig. 1.

b. Spores 5–6 x 1.5–2.5 μ.

35. Polyporus osseus Kalchb. Math. Term. Közlem. 3: 217. *pl. 1, f. 2.* 1865; Hedwigia 4: 141. 1865.

Polyporus Zelleri Murr. West. Polyp. p. 13. 1915.

Plate 29, fig. 3.

Pilei imbricate or caespitose-multiplex, cohesive to confluent,

fleshy-tough, drying rigid to horny, flabelliform or conchate, 2–8 x 2–10 x 0.5–0.9 cm.; surface tomentose to nearly glabrous, at first white, light gray to light yellowish-brown, drying wrinkled and Drab-Gray, Light Pinkish Cinnamon to Sayal Brown; margin thin, entire, undulating, occasionally lobed, concolorous or white, inflexed on drying; context fleshy, white, drying horny, Pale Ochraceous-Salmon, 3–8 mm. thick, usually with a paper-thin brown line adjacent to the tubes, hyphae of the context hyaline, septate and nodose-septate, thin-walled, undulating, profusely branched, of varying thicknesses, (6)8–12 μ in diameter; tubes decurrent, white to yellowish, drying Warm Buff to Ochraceous-Tawny, 1–3 mm. long; mouths angular, 4–6 per mm., concolorous with the tubes; dissepiments thin, 80–120 μ broad, becoming lacerate at the mouths; stipe lateral or excentric, confluent, occasionally branched, 4–12 mm. thick, 1–3 cm. long, color and substance similar to that of the pileus; hymenium hyaline, 8–12 μ thick; basidia hyaline, small, 8–9 x 3–4 μ; spores hyaline, smooth, cylindric, occasionally curved, 5–6 x 1.5–2.5 μ; no cystidia observed.

Habitat: attached to exposed dead roots of living *Picea Engelmanni;* on rotten coniferous wood, or on the ground in coniferous forests.

Distribution: montane zone. Scattered throughout northern United States.

Occurrence: rare. Summer and autumn.

Type of rot: unknown.

This is a rare plant in both America and Europe. As pointed out by Lloyd,[52] the European specimens are white when fresh and when dry, whereas the American ones are gray to yellowish-brown in color. *Polyporus Zelleri* is only a drab form of this species and represents the species as it is usually found in America.

Only a single collection of this plant is known from Colorado. This was collected by Kauffman at Leal, Colorado, in 1917, and reported as, ". . . at base of living trunk of Picea Engelmanni on the exposed dead part of a root."[53]

The particular growth-form illustrated in plate 29 is character-

[52] Lloyd, C. G. Synopsis of the stipitate Polyporoids. p. 191. 1912.
[53] Kauffman, C. H. *l. c.* p. 122.

istic of this plant. Furthermore, in mature specimens a very thin dark line is found adjacent to the tubes, but this is absent in young and immature ones.

TRAMETES

Trametes Fries, Gen. Hymen. p. 10. 1836.

Plants annual or perennial, lignicolous, coriaceous to corky, sessile, effused-reflexed, or resupinate; context varying in thickness and color, usually continuous with and of the same texture as the trama; tubes forming one or occasionally several layers, usually joined to the context in an uneven line so that they appear to be sunk into the context to unequal depths; pore-mouths circular, angular to daedaloid, usually of a large diameter; spores smooth, hyaline, elongate-ellipsoid to cylindric, occasionally curved; cystidia absent, setae and hyphal pegs present or absent.

This genus is not well differentiated from *Polyporus* on one hand, and from *Fomes*, on the other. The Friesian characterization, based on the continuity of the hyphae of the trama and context, has proved to be inadequate.[44] Indeed, it probably would be better to disregard this genus and place the so-classified plants in the genus *Polyporus* or *Fomes*, depending on their structure. Since, however, the genus *Trametes* is accepted by recent European and American writers, it would be unwise to disregard it here. Irrespective of the similarity between this and other genera, no difficulty should be experienced in identifying these plants, for all species of the genus *Trametes* are separated in the keys to the species of *Polyporus* and *Fomes*, as well as in the key to the species of *Trametes*.

KEY TO THE SPECIES[45]

Context white or whitish; setae and cystidia absent....1
Context light brown to wood-color; setae and cystidia absent....5
Context darker, dark brown to dark rusty-brown; setae present; cystidia none....6
Context rose-colored, pinkish or flesh-colored....9
1. Pileus more than 1 cm. thick....*41. T. hispida*
Pileus less than 1 cm. thick....2
2. Pileus brown, or with a conspicuous brown pubescence....3
Pileus white to whitish; pores 1–3 mm. broad; usually on coniferous hosts. ....*39. T. heteromorpha*

[44] Ames, A. Ann. Myc. 9: 211–253. 1913.
[45] See footnote, p. 318.

3. Mouths of the tubes averaging 2–3 or more per mm.; usually on conifers. ..... *37. T. serialis*
   Mouths of the tubes averaging 1–2 per mm. 4
4. Pileus less than 3 mm. thick; hymenium poroid, daedaloid to lamellate; on conifers. ..... *38. T. variiformis*
   Pileus more than 3 mm. thick; on deciduous hosts. ..... *41. T. hispida*
5. Context homogeneous, not containing a black line; pileus hirsute to hispid, yellowish-brown to brown. ..... *41. T. hispida*
   Context duplex, containing a thin black line; pileus finely tomentose to glabrous, umber-brown to blackish. ..... *40. T. stereoides*
6. Setae present in the hymenium. 8
   Setae absent. 7
7. Tubes whitish within; dissepiments rather thin; on conifers. ..... *42. T. odorata*
   Tubes not whitish within; dissepiments thin. ..... *56. Lenzites trabea*
8. Spores globose to subglobose; margin of the pileus lighter-colored than the rest of the pileus; pileus dark brown, zonate; mouths ochraceous-orange to brown. ..... *46. Fomes Pini*
   Spores cylindric; surface and margin of the pileus concolorous, zonate; mouths reddish-brown, slightly darker than the above. ..... *36. T. isabellina*
9. Sporophores ungulate. ..... *52. Fomes roseus*
   Sporophores dimidiate to conchate. ..... *43. T. subrosea*

1. Setae present and abundant.

36. Trametes isabellina Fries, Hymen. Eur. p. 585. 1874.

Fomes tenuis Karst. Medd. Soc. Fauna. Fl. Fenn. **14**: 81. 1887.

Polyporus tenuis (Karst.) Romell, Arkiv f. Bot. **11**[3]: 24. 1911. Not *Polystictus tenuis* Sacc. 1888.

Trametes setosus Weir, Jour. Agr. Res. **2**: 164. 1914.

Phellinus isabellinus (Fr.) Bourd. & Galz. Hymen. Fr. **1**: 622. 1927.

Trametes tenuis (Karst.) of most American authors.

Plate 30, figs. 1–2.

Sporophores annual or perennial, woody, conchate, sessile or effused-reflexed, imbricate, confluent, 0.5–2.5 x 1–15 x 0.2–1 cm., or entirely resupinate, 1–10 x 3–50 cm. or more; surface hirsute, zonate, Argus Brown, Mars Brown, Prout's Brown to almost black; margin even to undulating, at first rounded, velvety-tomentose, sterile, Antique Brown, with age becoming acute, fertile, and concolorous with the surface; context homogeneous, 1 mm. or less in thickness, Argus Brown to Brussels Brown,

hyphae of the context reddish-brown under the microscope, straight, apparently unbranched and aseptate, thin-walled, 2.5–3 μ in diameter; tubes rarely stratified, in effused-reflexed specimens often oblique, 1–10 mm. long each season, Sudan Brown to Brussels Brown, fulvous within; mouths concolorous with the tubes, round to angular, 3–5 per mm.; free ends of the dissepiments thick, tomentose, 50–100 μ thick; hymenium hyaline, incrusted, incrustation soluble in KOH solution, 8–10 μ broad; basidia hyaline, 3–4 μ broad; spores hyaline, smooth, cylindric, 6–9 x 2 μ; setae abundant, pointed, 7–9 μ broad at their bases, projecting up to 50 μ.

Habitat: on coniferous hosts, especially *Picea Engelmanni*.

Distribution: montane and subalpine zones. Widespread in the United States.

Occurrence: common. Summer and autumn.

Type of rot: white rot.

Due to the fact that this fungus is frequently found in a *Poria*-like growth-form, it would follow that it may have been described as a *Poria*. Overholts[16] is of the opinion that *Poria viticola* (*Fuscoporia viticola*), *P. contigua*, and *P. superficialis* are all closely related to *T. isabellina* and probably conspecific. Most of these *Porias*, however, have larger and more daedaloid pores than those described for *T. isabellina;* but as conceded by Overholts (*l. c.*), intermediate stages between these various conditions may be found. An adequate disposition of the *Porias* mentioned above can not at present be given by the writer, yet it seems advantageous to point out the fact that they are probably conspecific. These *Porias* are found on a wide range of deciduous hosts.

The reflexed portion of this fungus is never thick or *Fomes*-like, and it is scarcely probable that it could be confused with *Fomes Pini*. It does, however, have a close resemblance to *Fomes nigrolimitatus*, which differs chiefly in having a black line in the context. Compare *Poria ferruginosa* with resupinate specimens of this species.

2. Neither setae nor cystidia present in the hymenium.

A. Spores elongate-ellipsoid, large, 8 μ or more in length.

[16] Overholts, L. O. Mycologia **15**: 227–229. 1923; *ibid.* **23**: 127–128. 1931.

37. Trametes serialis Fries, Hymen. Eur. p. 585. 1874.
Polyporus serialis Fries, Syst. Myc. **1**: 370. 1821.
Polyporus callosus Fries, *ibid.* 381.
Polyporus scalaris Pers. Myc. Eur. **2**: 90. 1825.
Poria callosa (Fr.) Sacc. Syll. Fung. **6**: 298. 1888.
Coriolellus serialis (Fr.) Murr. N. Am. Fl. **9**: 29. 1907.

Plate 30, fig. 3.

Pileus coriaceous, effused-reflexed, occasionally resupinate, laterally confluent, narrowly reflexed, 0–2 x 1–15 x 0.3–1 cm.; surface appressed-tomentose, zonate, Warm Buff to Buckthorn Brown; margin thin, acute, undulating to lobed, concolorous; context thin, less than 1 mm., white, hyphae hyaline, branched, containing very few septa, incrusted, 2–4 μ in diameter; tubes white, 2–8 mm. long; mouths white to Light Buff, variable in size and shape, circular to angular, 2–3 per mm.; free edges of the dissepiments at first thick and entire, with age becoming thin and dentate, 120–250 μ thick; hymenium hyaline, rarely containing globose tuberculose masses of crystalline matter up to 15 μ in diameter, 15–22 μ thick; basidia hyaline, 5–6 μ broad; spores smooth, hyaline, cylindric-ellipsoid, 7–9 x 2–3(4) μ; no cystidia.

Habitat: on various coniferous and deciduous hosts.

Distribution: foothill, montane, and subalpine zones. Widespread in the United States.

Occurrence: uncommon. Summer and autumn.

Type of rot: brown rot.

The general growth-form of this fungus is effused-reflexed and similar to that of *T. variiformis* and *T. heteromorpha*. The latter two species, however, have large pores averaging 1 mm. or more in diameter, whereas *T. serialis* has very much smaller pores, averaging 2–3 per mm.

Poria callosa is the resupinate form of this species.

38. Trametes variiformis Peck, N. Y. State Mus. Bull. **28**: 220. 1899.
Polyporus variiformis Peck, Ann. Rept. N. Y. State Mus. **42**: 26. 1889.
Coriolellus serialis (Fr.) Murr. N. Am. Fl. **9**: 29. 1907. In part.

Plate 30, fig. 4.

Sporophores coriaceous, effused-reflexed, laterally connate, often entirely resupinate, 0.2–2 x 2–25 x 0.2–1 cm.; surface hirsute, zonate, Mummy Brown, Bone Brown to blackish; margin undulating, obtuse, hirsute, Mummy Brown, fertile below; context less than 1 mm. thick, duplex, upper layer concolorous with the surface, lower layer white, hyphae sparingly branched, incrusted, 4–6 μ in diameter; tubes 1–10 mm. long, usually obliquely arranged and opened laterally, Light Pinkish Cinnamon to Cinnamon-Buff; mouths concolorous, angular, daedaloid to labyrinthiform, averaging 1–2 per mm.; dissepiments with age becoming lacerate, thick, 200–600 μ; hymenium hyaline, compact, 20–30 μ broad; basidia hyaline, 7–9 μ broad; spores hyaline, smooth, elongate-ellipsoid, 8–12 x 4–5 μ; no cystidia.

Habitat: known only from coniferous hosts.

Distribution: montane and subalpine zones. Northern part of the United States.

Occurrence: common. Autumn.

Type of rot: white rot.

This fungus is frequently found in a resupinate growth-form, and then it may be confused with *T. heteromorpha* (see page 367). The effused sporophores, with their narrowly reflexed dark-colored margin and the obliquely arranged tubes, are characteristic.

39. Trametes heteromorpha (Fr.) Lloyd, Mycol. Notes **5**: 848. *f. 1416–1419.* 1919.

Daedalea heteromorpha Fries, Obs. Myc. **1**: 108. 1815.

Lenzites heteromorpha Fries, Epicr. Myc. p. 407. 1838.

Coriolellus Sepium (Berk.) Murr. Bull. Torr. Bot. Club **32**: 481. 1905. In part.

Coriolus hexagoniformis Murr. N. Am. Fl. **9**: 20. 1907.

Trametes laceratus Lloyd, Mycol. Notes **4**: 604. 1916.

Plate 31, fig. 2.

Sporophores coriaceous, effused-reflexed and laterally connate, often resupinate, 0.2–3 x 2–30 x 0.1–1 cm.; surface tomentose, zonate, white, Light Buff to Pinkish Buff; margin obtuse, undulating to lobed, tomentose, concolorous, fertile below; context 1

mm. or less thick, homogeneous, white to Light Buff, hyphae of the context hyaline, branched, incrusted, 3–5 μ in diameter; tubes 0.2–3 cm. long, often obliquely arranged and then opened laterally, Light Buff to Cinnamon-Buff; mouths angular, daedaloid to labyrinthiform, 1–3 mm. broad, concolorous with the tubes; dissepiments lacerate, rather thick, 250–300 μ; hymenium hyaline, compact, 20–40 μ broad; basidia hyaline, 6–8 μ broad; spores smooth, hyaline, elongate-ellipsoid, apiculate, 8–12 x 3–4 μ; no cystidia.

Habitat: mainly on conifers, especially *Picea Engelmanni*.

Distribution: montane and subalpine zones. Widespread through the northern part of the United States.

Occurrence: rare. Autumn.

Type of rot: brown rot.

Only a single collection of this fungus is known from Colorado. This was made on Pikes Peak by I. M. Johnston and sent to Lloyd for determination.

Trametes heteromorpha is characterized at once by its large pores and white or yellowish-white pileus. The closely related *T. variiformis*, in addition to having smaller pores than this species, has a dark-colored pileus. If, however, these species are found entirely resupinate, their identification rests entirely upon the size of the pores, for the spores and other hymenial characters are similar.

40. Trametes stereoides (Fr.) Bres. Hymen. Kmet. in Atti Accad. Roveret. III. **3**: 92. 1897.

Polyporus stereoides Fries, Obs. Myc. **2**: 259. 1818; Syst. Myc. **1**: 369. 1821.

Polyporus cervinus Pers. Myc. Eur. **2**: 87. 1825.

Daedalea mollis Sommerf. Suppl. Fl. Lapp. p. 271. 1826.

Trametes mollis (Sommerf.) Fries, Hym. Eur. p. 585. 1874.

Antrodia mollis (Sommerf.) Karst. Medd. Soc. Fauna Fl. Fenn. **5**: 40. 1879.

Plate 31, fig. 1.

Sporophores coriaceous, effused-reflexed or entirely resupinate, separable, reflexed portion imbricate, conchate, 0.5–4 x 1–10 x 0.2

–0.5 cm.; surface tomentose, zonate, uneven, Tawny-Olive, Bone Brown to almost black; margin thin, concolorous, at length revolute; context rarely over 1 mm. thick, duplex, Clay-Color next to the tubes, Tawny-Olive to Bone Brown above, separated by a paper-thin, black line, hyphae adjacent to the tubes hyaline under the microscope, much branched, 1–3 μ in diameter; tubes 1–4 mm. long, occasionally stuffed, avellaneous within; mouths variable in shape and size, circular to sinuous, averaging about 1 per mm., Cinnamon-Buff to Clay Color; dissepiments frequently torn, of varying thicknesses, 200–600 μ; hymenium hyaline, 18–22 μ broad; basidia hyaline, 5–7 μ in diameter; spores hyaline, smooth, cylindric, apiculate, occasionally curved, 9–12 x 3.5–4.5 μ; no cystidia.

Habitat: mainly on deciduous hosts, rare on conifers.

Distribution: montane and subalpine zones. Northern half of the United States.

Occurrence: rare. Autumn.

Type of rot: unknown.

This fungus is well marked by its large pores and brownish-colored duplex context. The black line between the layers of context is an important character, but should be correlated with other characters in order to avoid confusion with *Fomes nigrolimitatus*, *F. conchatus*, *Polyporus ovinus*, and *P. osseus*, which also have a similar black line in the context.

41. Trametes hispida Pass. Nuov. Giorn. Bot. Ital. **4**: 155. 1872.

Polyporus Lindheimeri Berk. & Curt. Grevillea **1**: 50. 1872.

Irpex grossus Kalchbr. *ibid.* **10**: 57. 1881.

Trametes Peckii Kalchbr. Bot. Gaz. **6**: 274. 1881.

Polystictus scuirinus Kalchbr. in Thüm. Pilz Fl. Sib. V. **14**: 897. 1882.

Polystictus Fergussoni Cooke, Grevillea **15**: 23. 1886.

Polystictus Celottianus Sacc. & Manc. in Sacc. Syll. Fung. **6**: 249. 1888.

Funalia stuppea (Berk.) Murr. Bull. Torr. Bot. Club **32**: 356. 1905.

Plate 31, fig. 3.

Pileus annual or perennial, corky, dimidiate, sessile or effused-reflexed, rarely subresupinate, imbricate, 2–10 x 2–25 x 0.5–5 cm.; surface clothed with long, stiff, erect, rarely adpressed hairs, 1–4 mm. in length, Sanford's Brown to Bay, fading with age to Cinnamon-Buff, azonate or occasionally indistinctly zonate; margin acute or rounded, entire or slightly undulate, concolorous, clothed with stiff hairs or else finely hirsute; in vertical section the hairy layer is 1–10 mm. thick, zonate in old and perennial specimens; context corky-hard, azonate, Clay Color, 0.2–2 cm. thick, hyphae of the context branched, septate, of two kinds: brown-colored, sparingly branched, 5–8 μ in diameter, and hyaline or yellowish-colored, profusely branched, 2–4 μ in diameter; tubes in annual specimens 2–10 mm. long, white within, in perennial forms the tubes are continuous up to 3 cm., older regions white-stuffed; trama of the tubes concolorous with the context; mouths angular to irregular, averaging about 1 per mm., Buckthorn Brown; dissepiments 90–300 μ thick; hymenium hyaline, 18–22 μ broad; basidia hyaline, 8–10 μ broad, projecting up to 12 μ; sterigmata 4–6 μ long; spores hyaline, smooth, cylindric, 12–14 x 4 μ; no cystidia observed.

Habitat: on various deciduous hosts, especially members of the Salicaceae.

Distribution: plains and foothill zones. Widespread in the United States.

Occurrence: common. Spring and summer.

Type of rot: white rot.

Smith[57] has recently reported that this fungus is a wound parasite of apple trees. The writer has found it to be a wound parasite of cottonwood (*Populus* spp.) trees on the campus of the University of Colorado.

The long brownish hairs on the pileus and the large basidia and spores distinctly mark this species.

The validity of the specific name used above for this fungus has been attacked by various writers. *Trametes gallica*, which has prior rank, is considered by Lloyd[58] as probably a thin form of *T. hispida*, but markedly different from the latter species as it

[57] Smith, E. C. Mycologia 22: 221–222. 1930.
[58] Lloyd, C. G. Mycol. Notes 4: 520. *f.* 517. 1912.

is known in America. He furthermore states that most of the European mycologists consider the former species to be valid and distinct. Bourdot and Galzin[59] place *T. gallica* in their "Espèces non observées, d'interprétation douteuse, ou de classification incertaine," whereas Bresadola[60] considers it to be conspecific with *T. hispida*. Murrill[61] considers *Trametes stuppeus*, which likewise has prior rank, to be synonymous with *T. hispida* (*T. Peckii*). Since in the recent work of Bourdot and Galzin (*l. c.*), *Trametes hispida* is considered to be the valid name, and since these workers had access to the types of both *Trametes gallica* and *T. stuppeus*, their precedence will be followed in this treatise. In so doing, the writer feels that there is an advantage in retaining the well-known name that more than compensates for juggling the species among doubtful prior names.

Many of the older mycological workers knew this plant under the name of *Trametes Peckii*, which is now generally conceded to be synonymous with *T. hispida*. Since the latter name is the older one, it should be used.

42. Trametes odorata (Wulf.) Fries, Epicr. Myc. p. 489. 1838.
Boletus odoratus Wulf. in Jacq. Collect. ad. Bot. **2**: 150. 1788.
Polyporus odoratus (Wulf.) Fries, Syst. Myc. **1**: 373. 1821.
Lenzites saepiaria porosa Peck in Port. & Coult. Fl. Colo., U. S. Dept. Int. Geol. & Geog. Surv. Misc. Publ. 4: 164. 1874.
Ochroporus odoratus (Wulf.) Schroet. Krypt. Fl. Schles. p. 488. 1889.
Gloeophyllum hirsutum (Schaeff.) Murr. Jour. Myc. **9**: 94. 1903. In part.
Trametes protracta Fr. of most American authors.

Plate 31, fig. 4.

Pileus annual or perennial, sessile, somewhat coriaceous, pulvinate to dimidiate, occasionally ungulate, 1–5 x 2–12 x 0.5–2 cm.; surface zonate, at first strigose-hirsute, Antique Brown to Russet, with age becoming adpressedly strigose to glabrous, Raw Umber, Mummy Brown to blackish, or with age bleaching

[59] Bourdot, H., & A. Galzin. Hymen. Fr. 1: 692. 1927.
[60] Bresadola in Sacc. Syll. Fung. 23: 378, 442, 479. 1925.
[61] Murrill, W. A. *l. c.*

to Avellaneous, Light Drab to Smoke Gray; margin rounded to obtuse, hirsute, concolorous or lighter, sterile below; context firm, homogeneous to indistinctly zonate, Argus Brown, occasionally lighter-colored near the surface, 0.5–3 cm. thick, hyphae of the context brown under the microscope, apparently unbranched, with few septa, rather thin-walled, 3–6 μ in diameter; tubes 0.3–1 cm. long, concolorous, fulvous within; mouths angular, daedaloid to labyrinthiform, irregular in size and shape, averaging 1–2 per mm., Cinnamon-Buff to Prout's Brown, walls thick and tomentose, with age becoming thin and glabrous; dissepiments of varying thicknesses, 200–800 μ; hymenium hyaline, compact, 35–40 μ thick; basidia hyaline, 5–7 μ broad, 4-spored; spores hyaline, smooth, cylindric to elongate-ellipsoid, apiculate, rarely curved, 8–12 x 3–5 μ; no cystidia observed.

Habitat: decorticated and charred coniferous wood. No deciduous hosts are known.

Distribution: from the foothill zone up to the subalpine zone. Widespread in the United States.

Occurrence: common. Spring, summer, and autumn.

Type of rot: brown rot.

In America, *Trametes odorata* has generally been known under the name of *T. protracta*, due to misinterpretations by earlier workers. In fact, the latter species appears to be very close to *Lenzites trabea* and probably is conspecific with it.

Murrill (*l. c.*) evidently was of the opinion that *T. odorata* was the poroid form of *Lenzites saepiaria*. The writer, however, has found the latter plant to be lamellate from the very earliest stage, whereas *T. odorata* may be labyrinthiform, but never truly lamellate. Snell *et al.*[42] have contributed rather conclusive evidence which supports the separation of these species.

This fungus is most always narrowly extended and of considerable length, and never *Fomes*-like in structure. The surface of the fruiting bodies usually bleaches with age to a grayish-color; more rarely, and in extremely damp locations, it becomes blackish.

B. Spores cylindric to allantoid, 6–8 x 2–3 μ.

[42] Snell, W. H., W. G. Hutchinson, and K. H. N. Newton. Mycologia **20**: 276–291. 1928.

43. **Trametes subrosea** Weir, Rhodora 25: 217. 1923.
Trametes carnea Cooke. In the American sense only.

Plate 32, fig. 1.

Pileus annual or perennial, sessile or effused-reflexed, dimidiate, often imbricate and longitudinally effused for a distance of 50 cm. or more, 2–6 x 2–15 x 0.5–2 cm.; surface zonate, at first velvety-tomentose, Salmon-Buff to Buff Pink, with age becoming radially adpressed-fibrillose or nearly glabrous, Fuscous, Dark Brown to black; margin acute, concolorous, or lighter, as Salmon-Buff to Buff Pink, sterile below; context 2–10 mm. thick, firm-corky, indistinctly multizonate, Japan Rose to Congo Pink, hyphae yellowish-brown under the microscope, sparingly branched, thick-walled, apparently aseptate, 3–5 μ in diameter; tubes concolorous with the context, indistinctly stratified, white-stuffed in the older layers, white-lined in the younger ones, 1–4 mm. long each season; mouths concolorous, round to slightly angular, 3–5 per mm.; dissepiments 60–140 μ broad, yellowish-brown; hymenium hyaline, 15–20 μ broad; basidia hyaline, 5–6 μ broad, projecting up to 8 μ, sterigmata up to 4 μ long; spores smooth, hyaline, cylindric, sometimes allantoid, 6–8 (9) x 2–3 μ; no cystidia observed.

Habitat: on various coniferous hosts, rare on deciduous ones.

Distribution: from the foothills up to the subalpine zone. Widespread in the United States.

Occurrence: common. Throughout the year.

Type of rot: brown rot.

As pointed out by Weir,[63] the American plant which he named *Trametes subrosea* differs fron *T. carnea* in that the surface of the former is zonate and velvety-tomentose, whereas that of the latter is glabrous and azonate. Up to comparatively recent times, this American plant has been called *T. carnea*.

Murrill[64, 65] combines *Trametes subrosea* (*T. carnea*) with *Fomes roseus*, and considers the former species to be only a growth-form of the latter. Weir (*l. c.*), however, points out distinct morpho-

[63] Weir, J. R. *l. c.*
[64] Murrill, W. A. North American Flora 9: 95. 1907.
[65] ————, Mycologia 12: 13. 1920.

logical differences; and recently, Snell *et al.*[66] further confirm the separation of these two species by presenting physiological differences. *Trametes subrosea* is always dimidiate and the context is dark rose-colored, whereas *Fomes roseus* is always ungulate and the context is light rose-colored.

Although this fungus is most frequently found on coniferous hosts, Zeller[67] has recently reported it to be a wound parasite on peach and plum trees.

GANODERMA

Ganoderma Karst. emend. Pat. Hymen. Eur. p. 142. 1887; Karsten, Rev. Myc. 3[9]: 17. 1881.

Pileus annual to perennial, sessile to stipitate; surface either laccate and shining or incrusted and dull; crust thick, rigid, brittle, formed of thickened hyphal elements; context light- to dark-brown; pores white to brown; spores truncate at their apexes when mature, yellow to brown under the microscope, epispore hyaline and smooth, endospore colored when mature and having wart- or spine-like processes extending into the epispore; setae and cystidia absent.

The outstanding characteristic of this genus is the colored, truncate spores, which usually have the appearance, under the oil-immersion lens, of being spined, verrucose, or punctate; but as explained by Coleman,[68] the outer spore wall is always smooth and hyaline, whereas the inner wall is colored and more or less spined. In addition to these spore characteristics, there also are external ones which are discernible to the unaided eye, as: laccate or heavily incrusted pileus and stipe (if present) and brown context.

The genus as defined above is in the sense of Karsten emended by Patouillard in 1887. Haddow[69] has recently reviewed the history of the genus and includes a critical study of several of the more common species. He follows Karsten's conception, which limits the genus to those species with varnished pilei and with the

[66] Snell, W. H., W. G. Hutchinson, and K. H. N. Newton. Mycologia 20: 276–291. 1928.

[67] Zeller, S. M. Jour. Agr. Res. 33: 687–693. 1926.

[68] Coleman, L. C. Bot. Gaz. 83: 48–60. 1927.

[69] Haddow, W. R. Jour. Arnold Arbor. 12: 25–46. 1931.

characteristic spore structure as previously defined. *Ganoderma applanatum* is not included because it lacks the varnished pileus. On the other hand, the writer wishes to emphasize the emendation by Patouillard who, not without reason, emphasized the spore structure rather than the varnished pileus. It is thought that by adopting this emendation less varying generic limitations are established.

44. Ganoderma applanatum (Pers.) Pat. Bull. Soc. Myc. Fr. **5**: 67. 1889.

Boletus lipsiensis Batsch, Elench. Fung. p. 183. *pl. 25, f. 130a, b.* 1786.

Boletus applanatus Pers. Obs. Myc. **2**: 2. 1799.

Polyporus applanatus (Pers.) Wallr. Fl. Crypt. Germ. **4**: 591. 1833.

Polyporus megaloma Lév. Ann. Sci. Nat. Bot. III. **5**: 128. 1846.

Polyporus leucophaeus Mont. Syll. Crypt. p. 157. 1856.

Fomes applanatus (Pers.) Gill. Champ. Fr. **1**: 686. 1878.

Fomes leucophaeus (Mont.) Cooke, Grevillea **14**: 18. 1885.

Fomes megaloma (Lév.) Cooke, *ibid.*

Placodes applanatus (Pers.) Quél. Fl. Myc. Fr. p. 400. 1888.

Elfvingia applanata (Pers.) Karst. Finl. Basidsv. p. 334. 1889.

Phaeoporus applanatus (Pers.) Schroet. Krypt. Fl. Schles., Pilze, 1 Hälfte, p. 490. 1889.

Ganoderma leucophaeum (Mont.) Pat. Bull. Soc. Myc. Fr. **5**: 73. 1889.

Elfvingia lipsiensis (Batsch) Murr. Bull. Torr. Bot. Club **30**: 297. 1903.

Elfvingia megaloma (Lév.) Murr. *ibid.* 300.

Ganoderma lipsiensis (Batsch) Atk. Ann. Myc. **6**: 189. 1908.

Plate 32, fig. 4.

Sporophores perennial, sessile, applanate, rarely ungulate, 5–30 x 5–50 x 1–15 cm.; surface plane or convex, concentrically furrowed, incrusted, crust broken due to the soft underlying context, pulverulent, never shining except where rubbed, variously

colored, as: Light Buff, Drab-Gray, Hair Brown, Cinnamon, Walnut Brown to blackish; margin round, sterile below, white to Light Buff; crust 1 mm. or less in thickness, horny, blackish or dark brown and shining in section, made up of irregularly arranged, swollen hyphal ends; context soft, zonate, 2–12 mm. thick, variously colored, as: Light Buff, Hazel to Carob Brown; hyphae of the context sparingly branched, undulating, thick-walled, brown, 4–7 μ in diameter; tubes evenly stratified, separated by a thin layer of context, 0.5–2 mm. thick, 3–18 mm. long each season, older ones usually white-stuffed, young ones approximately concolorous with the context; mouths circular, 4–6 per mm., when young white, Cartridge Buff to Massicot Yellow, turning darker where bruised, with age becoming concolorous with the tubes; dissepiments thin, 40–80 μ broad; hymenium hyaline to yellowish under the microscope, 16–25 μ thick, containing simple or forked, unequally thickened hyphae which extend beyond the basidia and which do not have the characteristics of cystidia; basidia hyaline to yellowish, 5–7 μ broad; spores brown, appearing to be minutely spined, ovoid, truncate, 8–9 x 5–6 μ.

Habitat: deciduous hosts, especially species of *Populus* and *Betula;* rare on conifers.

Distribution: montane zone. Widespread in the United States.

Occurrence: frequent. Throughout the year.

Type of rot: white rot.

The spores found on the upper surface of the pileus are basidiospores that were carried there by convection currents of air. They were previously considered to be conidia until White[70] definitely disproved this assumption. The spore structure, the brown context, and the horny crust distinctly characterize this species.

Although this species does not have a varnished crust, which to some extent characterizes this genus, its cellular structure is nevertheless essentially the same as that of the crust of varnished members. The crust is composed of swollen hyphal ends irregularly arranged, whereas in the species with a varnished crust the swollen hyphal ends are arranged in a palisade-like layer.

[70] White, J. H. Trans. Roy. Can. Inst. 12: 133–174. 1920.

The spores of *G. applanatum* are similar in structure to those found in species having a varnished crust. These characteristics seem to warrant the inclusion of this species in the genus *Ganoderma* as emended by Patouillard, and as included by him.

Both the light- (*Fomes leucophaeus*) and dark-colored forms are found in Colorado; the former form, however, is more frequently encountered.

This fungus is both parasitic and saprophytic on a wide range of deciduous and coniferous hosts (White, *l. c.*), but in Colorado it occurs most frequently on dead *Populus tremuloides*.

FOMES

Fomes (Fr.) Gill. Champ. Fr. 1: 682. 1878; Fries, Nov. Symb. p. 31. 1851.

Plants always at length perennial, lignicolous, corky to woody, usually large and massive, ungulate to applanate, sessile, occasionally effused-reflexed; surface incrusted or anoderm; context of varying thicknesses and colors; tubes at length stratified, strata may or may not be separated by a layer of context; pore-mouths circular, angular to daedaloid; spores smooth, variously shaped and colored; cystidia and setae present or absent.

The genus *Fomes* contains all large perennial plants (except *Ganoderma*) with ungulate or applanate fruiting bodies. Exceptions to this, however, may be found in *F. ohiensis* and *F. scutellatus*, in which the fruiting bodies rarely exceed 3 cm. in breadth.

Fomes differs from *Ganoderma* chiefly in the presence of a thick shining or dull crust and spined spores in the latter. The fruiting bodies of some species of *Trametes* at times may be perennial and have stratified tube-layers; however, these fruiting bodies are never *Fomes*-like in structure, or never large and massive and not usually ungulate. Members of the genus *Daedalea* and *Lenzites* may be perennial, but they never have stratified tube- or lamellae-layers.

KEY TO THE SPECIES[n]

Context white, whitish, or very light yellowish-brown; setae never present; cystidia present or absent.....1

Context darker than the above, wood-brown, dark yellowish-brown to brown; setae present or absent; cystidia never present.....4

[n] See footnote, p. 318.

Context of a definite rose-color....9
1. Plants growing on living or dead *Shepherdia;* pileus with a reddish tinge when young, blackish when older....*53. F. fraxinophulis* f. *Ellisianus*
Plants growing on hosts other than *Shepherdia*....2
2. Pileus not more than 2 cm. thick; usually effused-reflexed with a very narrow reflexed part....*54. F. annosus*
Pileus thicker than the above....3
3. Mouths averaging (1)2–3 per mm.; plants growing only on species of *Juniperus*....*51. F. Demidoffii*
Mouths averaging 4–5 per mm.; plants growing on various coniferous and deciduous hosts....*45. F. pinicola*
4. Pileus with a thick horny crust; spores brown, minutely spined, truncate; no setae....*44. Ganoderma applanatum*
Pileus not heavily incrusted; spores smooth, hyaline or yellowish; setae present....5
5. Context containing a thin black line less than 1 mm. broad....6
Context not containing a black line as above....7
6. Plants confined to coniferous hosts....*47. F. nigrolimitatus*
Plants confined to deciduous hosts....*50. F. conchatus*
7. Growing only on living or dead conifers; pileus dark brown to blackish ....*46. F. Pini*
Growing only on deciduous hosts; context dark reddish-brown....8
8. Growing only on species of *Prunus;* mouths averaging 5–6 per mm.; producing a brown rot....*49. F. fulvus*
Growing on various deciduous hosts, especially aspen; mouths averaging 3–4 per mm.; producing a white rot....*48. F. igniarius*
9. Sporophores ungulate....*52. F. roseus*
Sporophores dimidiate to conchate....*43. Trametes subrosea*

1. Cystidia present and needle-like; setae absent.

45. Fomes pinicola (Sw.) Cooke, Grevillea **14**: 17. 1885.

Boletus ungulatus Schaeff. Fung. Bavar. **4**: 88. *pl. 137, 138.* 1774.

Boletus fulvus Schaeff. *ibid.* 89. *pl. 262.* Not *Boletus fulvus* Scop. 1772.

Boletus semiovatus Schaeff. *ibid.* 92. *pl. 270.*

Boletus marginatus Pers. Obs. Myc. **2**: 6. 1799.

Boletus pinicola Sw. Sv. Vet.-Akad. Handl. **1810**: 88. 1810.

Polyporus marginatus (Pers.) Fries, Syst. Myc. **1**: 372. 1821.

Polyporus pinicola (Sw.) Fries, *ibid.*

Fomes marginatus (Pers.) Gill. Champ. Fr. **1**: 683. 1878.

Fomitopsis pinicola (Sw.) Karst. Rev. Myc. **3**[9]: 18. 1881.

Fomes ungulatus (Schaeff.) Sacc. Syll. Fung. **6**: 167. 1888.

Ungulina marginata (Pers.) Pat. Ess. Tax. Hymen. p. 103. 1900.

Fomes ponderosus von Schrenk, U. S. Dept. Agr. Bur. Pl. Ind. Bull. 36: 30. 1903.

Plates 33, 34, figs. 1–2.

Pileus sessile, sometimes entirely resupinate, ungulate or applanate, woody, 3–20 x 3–20 x 1–10 cm.; surface glabrous, sometimes powdery, pelliculose or anoderm, usually sulcate, Light Buff to Pale Yellow-Orange when young, later Apricot Buff, Pecan Brown to almost black, often resinous when found on conifers; margin at first rounded, later obtuse and frequently of a lighter color than the rest of the pileus, often sterile below; context in young plants up to 4 cm. thick, in old specimens 1–5 mm. thick, corky to woody, white to Light Buff, hyphae of the context brownish under the microscope, unbranched, thick-walled, sometimes incrusted, 5–7 μ in diameter; tubes 2–5 mm. long each season, Light Buff, Pinkish Buff, to Cinnamon; mouths round, white, Maize Yellow to Light Buff, sometimes Wax Yellow, decidedly yellow-brown where bruised, averaging 4–5 per mm.; dissepiments 120–160 μ thick; trama golden under the microscope, occasionally containing brown crystalline bodies; hymenium 18–22 μ thick, loosely arranged; basidia 4-spored, 6–7 μ broad; spores hyaline, smooth, ovoid, 6–8 x 4–5 μ; hair-like cystidia usually present, 3–4 μ in diameter at their bases and tapered to a sharp point, extending up to 30 μ beyond the general level of the hymenium.

Habitat: parasitic and saprophytic on all conifers; occasionally found on *Populus tremuloides*.

Distribution: from the foothills up to the subalpine zone. Widespread in the United States.

Occurrence: very common. Throughout the year.

Type of rot: cubical brown rot.

Very young specimens of this fungus are almost globose, of a light yellow color, and often devoid of a hymenium, but later become sulcate, ungulate, or applanate, and of a darker color. Sporophores collected from coniferous hosts usually are covered with a sticky resinous exudation. This exudation, however, is never found on specimens from aspen. Occasionally, the fungus is entirely resupinate.

The needle-like cystidia are present only in mature hymenia

and entirely absent in young ones. In some cases, when KOH solution is applied to the tubes, they change to a reddish-brown color. This test, however, is not an infallible specific demarcation. Schmitz[72] suggests that various strains of this fungus probably exist in nature.

2. Setae present, cystidia absent.

A. Setae always present and abundant.

46. Fomes Pini (Thore) Lloyd, Synop. Fomes, p. 275. 1915.
Boletus Pini Thore, Chlor. Land. p. 487. 1803; Brot. Fl. Lusit. **2**: 468. 1804.
Daedalea Pini (Thore) Fries, Syst. Myc. **1**: 336. 1821.
Polyporus Pini (Thore) Pers. Myc. Eur. **2**: 83. 1825.
Trametes Pini (Thore) Fries, Epicr. Myc. p. 489. 1838.
Fomes Abietis Karst. Bidr. Finl. Nat. Folk **37**: 242. 1882.
Polyporus piceinus Peck, Ann. Rept. N. Y. State Mus. **42**: 25. 1889.
Trametes Pini Abietis Karst. Finl. Basidsv. p. 336. 1889.
Polystictus piceinus (Pk.) Sacc. Syll. Fung. **9**: 187. 1891.
Porodaedalea Pini (Thore) Murr. Bull. Torr. Bot. Club **32**: 367. 1905.

Plate 32, figs. 2–3.

Sporophores normally perennial, woody, ungulate to conchate, sessile, effused-reflexed or resupinate, often imbricate, confluent, 1–15 x 1–30(60) x 0.5–15 cm.; surface rough, sulcate, zonate, becoming rimose with age, hirsute, tomentose to glabrous, Argus Brown, Burnt Umber to black; margin rounded to acute, usually sterile below, velvety-tomentose, concolorous with the surface or more often lighter-colored as: Amber Brown to Brussel's Brown; context woody, usually less than 5 mm. thick, homogeneous, rarely zonate, Amber Brown to Argus Brown, hyphae of the context brownish under the microscope, rarely branched, 3–5 μ in diameter; tubes indistinctly stratified, usually stuffed in the older layers, rarely so in the new layers, 2–10 mm. long each season, concolorous with the context in older specimens, in young specimens Clay Brown to Wood Brown within; mouths circular,

[72] Schmitz, H. Am. Jour. Bot. **12**: 163–176. 1925.

angular, or daedaloid, often of unequal diameter, 2–5 per mm., Wood Brown, Antique Brown, to Argus Brown; dissepiments very thin, 250 μ or more; hymenium hyaline under the microscope, 16–22 μ thick; basidia small, 4 μ broad; spores at first hyaline but turning light brown when mature, smooth, globose, 4–5 μ, or subglobose, 4–5(6) x 3.5–4 μ; setae abundant, pointed, projecting up to 20–30 μ beyond the hymenium, 8–12 μ in diameter.

Habitat: parasitic and saprophytic on conifers; rare on *Crataegus*.

Distribution: montane and subalpine zones. Widespread in the United States.

Occurrence: common. Throughout the year.

Type of rot: white rot.

As might be expected, one-year-old specimens of this fungus are more brightly colored than older ones. Due to this difference in appearance, the annual plants have previously been placed in *Fomes Abietis*, *Trametes Pini Abietis*, and *Polyporus* (*Polystictus*) *piceinus;* however, in the light of our present knowledge, these names should be considered conspecific. This species is sometimes called *Trametes Pini*, but since it develops into a large ungulate plant, it is thought advisable to consider it as a *Fomes*.

Compare *Fomes nigrolimitatus*, which has a black line at the base of its tube-layer, and *Trametes isabellina*, which has a light chocolate-colored pore layer. All of the above three plants have abundant setae in their hymenia.

47. Fomes nigrolimitatus (Romell) Egeland, Nyt Mag. **52**: 135. 1914.

Polyporus nigrolimitatus Romell, Arkiv f. Bot. **11**[3]: 18. *pl. 1, f. 3.* 1911.

Phellinus nigrolimitatus (Romell) Bourd. & Galz. Hymen. Fr. **1**: 622. 1927.

Plate 38, figs. 2–3.

Pileus corky, effused-reflexed, most frequently entirely resupinate, 1–5 x 4–20 x 1–5 cm., when entirely resupinate up to 30 x 60 cm.; surface at first soft, azonate, tomentose, anoderm, with age becoming woody, indistinctly zonate, and covered with

a thin brittle pellicle, at first Hazel to Bay, fading with age to Ochraceous-Tawny or almost black; margin acute to rounded, tomentose, Bay, sterile below; context soft and spongy, Kaiser Brown to Bay, 0.2–5 cm. thick, containing a thin black line less than 1 mm. thick and approximately 1 mm. above the tubes, context adjacent to the tubes lighter in color than the rest of the context, hyphae brown under the microscope, sparingly branched, 3–8 μ in diameter; tubes at length stratified, strata may be separated from each other by a narrow band of context about 1 mm. thick and containing a thin black line, or more frequently the tube-layers are stratified without the interception of layers of context, 0.2–2 cm. long each season, Sudan Brown to Brussels Brown, yellowish within; mouths circular to angular, concolorous with the tubes or in weathered specimens slightly darker, averaging 4–6 per mm.; dissepiments 60–100 μ broad; hymenium hyaline, made up of loosely arranged hyphae, 18–22 μ broad; basidia hyaline, 5–7 μ broad; spores hyaline, smooth, cylindric to elongate-ovoid, 6–8 x 2–3 μ; setae abundant, pointed, 8–10 μ broad, projecting up to 35 μ.

Habitat: on conifers, especially *Picea Engelmanni*.

Distribution: montane and subalpine zones. At the present time, known only from the Rocky Mountain region in the United States.

Occurrence: common. Throughout the year.

Type of rot: white pocket rot.

Of the various pore fungi found on coniferous hosts, the black line in the context and the abundant setae distinctly mark this plant. In most cases, the black line is so narrow that it can be seen only with the aid of a hand lens. The fruiting bodies most frequently found have only a single layer of tubes, and are almost always resupinate. Rarely is the species found with a narrowly reflexed margin. Compare with *Fomes conchatus* which is found only on deciduous hosts.

The type collection of *Fomes putearius* likewise has a black line in a similar position in the context and the plant looks very much like *F. nigrolimitatus*. Hubert[73] is of the opinion that these two species are conspecific, but Overholts[74] reports that the spores of

[73] Hubert, E. E. Jour. Agr. Res. 29: 528. 1924; Outline of forest pathology. p. 381. 1931.

[74] Overholts, L. O. Mycologia 23: 127. 1931.

F. putearius are hyaline, subglobose, 4–5 × 3–4 μ; hence they are markedly different in shape and size from those of *F. nigrolimitatus*, which are cylindric to elongate-ovoid, 6–8 × 2–3 μ. The writer has examined the type collection of *F. putearius*, but he was unable to find spores.

B. Setae not abundant, sometimes apparently absent.

48. Fomes igniarius (L.) Gill. Champ. Fr. **1**: 687. 1878.
Boletus igniarius L. Sp. Pl. p. 1176. 1753.
Polyporus igniarius (L.) Fries, Syst. Myc. **1**: 375. 1821.
Polyporus nigricans Fries, *ibid.*
Polyporus hyperboreus Berk. Ann. & Mag. Nat. Hist. **7**: 453. 1841.
Polyporus Novae-Angliae Berk. & Curt. Grevillea **1**: 51. 1872.
Fomes nigricans (Fr.) Gill. Champ. Fr. **1**: 685. 1878.
Phellinus igniarius (L.) Quél. Ench. Fung. p. 172. 1886.

Plate 35.

Pileus ungulate, rarely applanate, sessile or occasionally resupinate, 1–10 x 2–20 x 1–12 cm.; surface at first smooth, with age becoming distinctly rimose, incrusted, zonate, hirsute to glabrous, grayish-black to black; margin obtusely rounded, sterile below, hirsute-tomentose, not rimose, Ochraceous-Tawny to Sudan Brown, rarely grayish; context usually less than 1 mm. thick, concolorous with the surface, hyphae of the context dark-brown under the microscope, rarely branched, 3–4 μ in diameter; tube-layers stratified and forming the bulk of the fruiting body, tubes conspicuously white-stuffed in the older layers, 1–5 mm. long each season, Chestnut to Bay; mouths circular, 3–4 per mm., Bay to Chestnut, rarely grayish; dissepiments 40–90 μ thick; hymenium thin, hyaline, 8–10 μ thick; spores smooth, hyaline, subglobose to ovoid, 6–7 x 3–4 μ, abundant; setae infrequent, sometimes apparently absent, pointed, projecting 12–16 μ beyond the hymenium, 6–8 μ broad at their bases.

Habitat: on living and dead deciduous hosts, especially *Populus tremuloides;* rare on *Picea.*

Distribution: montane zone. Widespread in the United States.

Occurrence: common. Throughout the year.

Type of rot: white rot.

This fungus is closely related to *Fomes fulvus* in that the microscopical characters of the two plants are apparently similar. However, they can be conveniently separated as follows: *Fomes igniarius* causes a white rot and is found mainly on species of *Populus*, whereas *F. fulvus* causes a brown rot and is found only on species of *Prunus*.

Fomes igniarius attacks living aspen trees and, according to Meinecke,[75] causes an appreciable damage in certain parts of Colorado.

49. Fomes fulvus (Scop.) Gill. Champ. Fr. **1**: 687. 1878.

Boletus fulvus Scop. Fl. Carn. ed. 2. **2**: 469. 1772. Not *Boletus fulvus* Schaeff. 1774.

Boletus pomaceus Pers. Obs. Myc. **2**: 5. 1799.

Polyporus pomaceous Pers. Myc. Eur. **2**: 84. 1825.

Polyporus fulvus (Scop.) Fries, Epicr. Myc. p. 466. 1838.

Placodes pomaceus (Pers.) Quél. Fl. Myc. Fr. p. 399. 1888.

Placodes fulvus (Scop.) Quél. *ibid.*

Pyropolyporus fulvus (Scop.) Murr. Bull. Torr. Bot. Club **30**: 112. 1903.

Fomes pomaceus (Pers.) Big. & Guill. Fl. Champ. Fr. **2**: 355. 1913.

Plate 34, figs. 4–6.

Pileus dimidiate to ungulate, occasionally imbricate, sessile, effused-reflexed, rarely resupinate, 1–10 x 2–15 x 1–6 cm.; surface at first smooth, with age becoming more or less rimose and incrusted, indistinctly zonate, hirsute to glabrous, Hair Brown to Deep Mouse Gray; margin obtusely rounded, sterile below, hirsute-tomentose, not rimose, Ochraceous-Tawny to Sudan Brown; context 1–5 mm. thick, concolorous with the surface, hyphae of the context dark-brown under the microscope, rarely branched, 3–4 μ in diameter; tube-layers stratified, forming the bulk of the fruiting body, tubes in the older strata occasionally white-stuffed but not markedly so, 1–5 mm. long each season, Chestnut to Bay; mouths circular, (4)5–6 per mm., Bay to Chestnut Brown; dissepiments 40–90 μ thick; hymenium thin and

[75] Meinecke, E. P. U. S. Dept. Agr., Tech. Bull. 155. 1929.

hyaline, 8–10 μ thick; spores smooth, hyaline, subglobose to ovoid, 6–7 x 3–4 μ; setae infrequent, sometimes apparently absent, pointed, projecting 12–16 μ beyond the hymenium, 6–7 μ broad at their bases. Spores and setae are the same as those in *Fomes igniarius*.

Habitat: on various species of the genus *Prunus*.

Distribution: montane zone. Widespread in the United States.

Occurrence: rare. Summer and autumn.

Type of rot: brown rot.

See page 383 for a discussion of this species and its comparison with *Fomes igniarius*.

50. Fomes conchatus (Pers.) Gill. Hymen. Fr. p. 685. 1874.

Boletus salicinus Pers. in Gmel. Syst. Nat. **2**: 1437. 1791. Not *Boletus salicinus* Bull. 1789.

Boletus conchatus Pers. Obs. Myc. **1**: 24. 1796.

Polyporus conchatus (Pers.) Fries, Syst. Myc. **1**: 376. 1821.

Polyporus salicinus (Pers.) Fries, *ibid.*

Polyporus loricatus Pers. Myc. Eur. **2**: 86. 1825.

Phellinus salicinus (Pers.) Quél. Fl. Myc. Fr. p. 394. 1888.

Pyropolyporus conchatus (Pers.) Murr. Bull. Torr. Bot. Club **30**: 117. 1903.

Pileus woody, rigid, effused-reflexed with the reflexed portion conchate, broadly effused and often entirely resupinate, 0–6 x 3–10 x 0.3–2 cm.; surface tomentose, irregularly sulcate, anoderm, Auburn to Mars Brown, with age becoming incrusted and almost black; margin acute, undulating, tomentose, Tawny to concolorous, sterile below; context woody, usually very thin, 0.5–3 (8) mm. thick, indistinctly zonate, containing one to several black lines less than 1 mm. in thickness, Antique Brown, hyphae brown under the microscope, thick-walled, with few septa, 1.5–4 μ in diameter; tubes concolorous with the context, at length stratified, 0.5–4 mm. long each season; mouths circular, 5–7 per mm., Antique Brown to Sudan Brown; dissepiments 35–50 μ broad; hymenium hyaline, narrow, 6–10 μ broad; basidia hyaline, 4–6 μ in diameter; spores hyaline, smooth, sugblobose to ovoid, 4–6 x 4–5 μ; setae ventricose, 6–10 μ broad at their bases, projecting 10–20 μ beyond the hymenium, never extremely numerous and often somewhat

rare in occurrence, similar in shape to those of *F. igniarius* and *F. fulvus*.

Habitat: on various deciduous hosts.

Distribution: montane and subalpine zones. Somewhat widespread in the United States.

Occurrence: rare. Summer and autumn.

Type of rot: white rot.

This species was collected only once in Colorado, and this collection was made by Baker, Earle, and Tracy in 1898.[76]

Fomes conchatus is usually a thin plant and scarcely has the appearance of a *Fomes;* it is often entirely resupinate, and the context contains one to several thin black lines that can be seen only with the aid of a hand lens. As to color, growth-form, and presence of a black line in the context, this fungus is similar to *Fomes nigrolimitatus*. The latter species, however, differs in host relations, in the size, shape, and abundance of the setae, and in the size and shape of the spores.

3. Neither cystidia nor setae present in the hymenium.

A. Spores yellowish-colored and markedly truncate.

51. Fomes Demidoffii (Lév.) Sacc. & Sydow, in Sacc. Syll. Fung. **6:** 189. 1888.

Polyporus Demidoffii Lév. in Demid. Voy. Russ. Merid. **2:** 92. 1842; *ibid.* Atlas Crypt. *pl. 3.* 1842.

Polyporus Juniperinus von Schrenk, U. S. Dept. Agr. Bull. Veg. Phys. 21: 9. 1900.

Fomes Juniperinus (von Schrenk) Sacc. & Sydow, in Sacc. Syll. Fung. **16:** 151. 1902.

Pyropolyporus Juniperinus (von Schrenk) Murr. Bull. Torr. Bot. Club **30:** 116. 1903.

Pyropolyporus Earlei Murr. *ibid.*

Fomes Earlei (Murr.) Sacc. & D. Sacc. in Sacc. Syll. Fung. **17:** 119. 1905.

Fulvifomes Juniperinus (von Schrenk) Murr. North. Polyp. p. 501. 1914.

Plate 34, fig. 3.

[76] Greene, E. L. Plantae Bakerianae **1:** fasc. 1, p. 24. 1901.

Pileus woody, ungulate, 3–10 x 3–12 x 3–15 cm.; surface at first tomentose, yellowish-brown, zonate, at length becoming glabrous, Sepia to blackish, rimose; margin rounded, tomentose, at first Warm Buff, with age and on bruising becoming Amber Brown; context zonate, Amber Brown to Kaiser Brown, 3–10 mm. thick, hyphae of the context brown under the microscope, thick-walled, apparently aseptate, rarely branched, 3–4 μ in diameter; tubes indistinctly stratified, concolorous with the context, 5–10 mm. long each season; mouths angular to irregular, (1)2–3 per mm., concolorous with the tubes; dissepiments 125–175 μ thick; hymenium yellowish-brown under the microscope, loosely arranged, indistinctly delimited from the trama, 35–40 μ broad; basidia yellowish-brown, 7–8 μ broad; spores smooth, yellowish-brown, ovoid, truncate, 6–8 x 4–5 μ, copious; typical cystidia absent, large, club-shaped bodies, which are considered as immature basidia, frequently abundant.

Habitat: confined to living and dead members of the genus *Juniperus*.

Distribution: plains and foothill zones. Widespread in the United States.

Occurrence: common. Throughout the year.

Type of rot: white rot.

According to Lloyd,[77] Murrill,[78] Seymour,[79] and Bourdot and Galzin,[80] *Fomes Demidoffii* is not distinct from *F. Juniperinus*. Since the former name is the older one, it is advisable to employ it here.

Even though Hedgcock and Long[81] have pointed out the fact that *Fomes Earlei* and *F. Juniperinus* produce slightly different rots and have pores of different size, the writer is of the opinion that these species are conspecific and that these differences may be attributed to the different hosts upon which the fungi grow, and also to the different geographic locations of the collections of the rots and fruiting bodies.

Many collections of this fungus have been made in Colorado

[77] Lloyd, C. G. Mycol. Notes 4: 522. 1912; Syn. Fomes, p. 232. 1915.
[78] Murrill, W. A. Mycologia 12: 14. 1920.
[79] Seymour, A. B. Host Index, p. 76. 1929.
[80] Bourdot, H. & A. Galzin. Hymen. Fr. 1: 689. 1927.
[81] Hedgcock, G. G. & W. H. Long. Mycologia 4: 109–114. 1912.

by Hedgcock on junipers found on dry bluffs and mesas of the foothill zone. Its occurrence, however, is not coextensive with that of the hosts; on the contrary, the fungus is found on widely scattered groups of junipers.

B. Spores hyaline, truncate or not truncate.

a. Spores allantoid.

52. Fomes roseus (Alb. & Schw.) Cooke, Grevillea **14**: 21. 1885.

Boletus roseus Alb. & Schw. Consp. Fung. p. 251. 1805.

Polyporus roseus (Alb. & Schw.) Fries, Syst. Myc. **1**: 372. 1821.

Polyporus rufo-pallidus Trog, Flora **15**: 556. 1832.

Fomitopsis rosea (Alb. & Schw.) Karst. Rev. Myc. **3**[9]: 18. 1881.

Ungulina rosea (Alb. & Schw.) Pat. Ess. Tax. Hymen. p. 103. 1900.

Plate 29, figs. 4–6.

Pileus coriaceous-woody, sessile, effused-reflexed, ungulate, 1–5 x 1–6 x 1–4 cm.; surface anoderm, sulcate, rimose, tomentose to nearly glabrous, Fuscous-Black to black; margin round, Natal Brown to concolorous, sterile below; context 0.5–2 cm. thick, corky-firm, indistinctly zonate, Shell Pink to Vinaceous Pink, hyphae of the context yellowish-brown under the microscope, sparingly branched, thick-walled, apparently aseptate, 3–5 μ in diameter; tubes concolorous with the context, stratified, white-stuffed in the older strata, white-lined in the younger ones, 1–3 mm. long each season; mouths concolorous or slightly darker in weathered specimens, round to slightly angular, 3–5 per mm.; dissepiments 60–140 μ thick, yellowish-brown; hymenium hyaline, 14–18 μ thick; basidia hyaline, 5–6 μ in diameter, projecting up to 6 μ; spores hyaline, smooth, cylindric, rarely curved, 6–9 x 2–3 μ; no cystidia observed.

Habitat: on conifers.

Distribution: foothill, montane, and subalpine zones. Widespread in the United States.

Occurrence: rare. Autumn.

Type of rot: brown rot.

This fungus is separated from *Trametes subrosea* by its lighter rose-colored context and its ungulate growth-form. It is of rare occurrence in Colorado, and nowhere in the United States is it found in great abundance. Weir[82] reports it as occurring only on conifers.

b. Spores ovoid.

53. Fomes fraxinophilus forma **Ellisianus** (And.) Baxter, Am. Jour. Bot. **12**: 523. 1925.

Fomes Ellisianus Anderson, Bot. Gaz. **16**: 113. 1891.

Polyporus circumstans Morgan, Jour. Cinc. Soc. Nat. Hist. **18**: 37. 1895.

Plate 37, fig. 3.

Pileus woody, dimidiate, ungulate, 3–10 x 3–15 x 2–10 cm.; surface at first tomentose, radiate-rugose, Kaiser Brown to Bay, with age becoming rimose and blackish; margin obtuse to rounded, concolorous or lighter, as Pinkish Buff; context scanty, usually less than 5 mm. thick, Pinkish Buff to Warm Buff, hyphae of the context yellowish-brown under the microscope, very thick-walled, easily broken, with very few septa, apparently unbranched, 4–5 μ in diameter; tubes indistinctly stratified, concolorous with the context, 3–6 mm. long each season, slightly stuffed in the older strata; pores concolorous with the tubes, circular to subcircular, 2–4 per mm.; free edges of the dissepiments at first pruinose, with age becoming glabrous, 80–150 μ thick; hymenium hyaline, 12–16 μ thick; basidia hyaline, 7–8 μ broad; spores smooth, hyaline, ovoid, occasionally truncate, 7–8 x 5–6 μ; no cystidia observed.

Habitat: on living and dead *Shepherdia argentea*.

Distribution: plains and foothill zones. Rocky Mountain region.

Occurrence: abundant where the host occurs. Throughout the year.

Type of rot: white rot.

This fungus has the general appearance of both *Fomes fraxinophilus* and *F. Demidoffii*, but the latter two species have darker-

[82] Weir, J. R. Rhodora **25**: 214–220. 1923.

colored contexts and tubes. Baxter[83] has presented cultural and morphological characteristics of this fungus and *F. fraxinophilus*, and shows them to be closely related.

54. Fomes annosus (Fr.) Cooke, Grevillea **14**: 20. 1885.
Polyporus annosus Fries, Syst. Myc. **1**: 373. 1821.
Polyporus serpentarius Pers. Myc. Eur. **2**: 82. 1825.
Polyporus subpileatus Weinm. Syll. Pl. Nov. **2**: 102. 1827.
Polyporus resinosus Rostk. in Sturm, Deutsch. Fl. **4**:61. 1830. Not *Polyporus resinosus* (Schrad.) Fr. 1821.
Trametes radiciperda R. Hartig, Wicht. Krankh. Waldb. p. 62. 1874.
Fomitopsis annosa (Fr.) Karst. Rev. Myc. **3**[9]: 18. 1881.
Polyporus Gillotii Roum.; Gillot, Rev. Myc. **4**: 234. *pl. 32.* 1882.
Heterobasidion annosum (Fr.) Bref. Unters. Gesammt. Myk. **8**: 154. 1889.
Polyporus irregularis Underw. Bull. Torr. Bot. Club **24**: 85. 1897.
Ungulina annosa (Fr.) Pat. Ess. Tax. Hymen. p. 103. 1900.

Plate 36.

Sporophores resupinate, effused-reflexed, or sessile, woody, irregular in shape, usually conchate to applanate, 5–12 x 5–18 x 0.5–2 cm.; surface velvety to nearly glabrous, rugose, zonate, more or less incrusted, new growth Cinnamon-Buff to Clay Color, older growth Rood's Brown, Natal Brown to blackish; margin entire to wavy-lobed, acute, concolorous with the new growth, sterile below; annual tube-layers loosely cemented together at their margins; context 2–10 mm. thick, woody, white to Pale Ochraceous-Buff, upper part forming a hard, horny, and black or very dark brown pellicle, 0.2–0.3 mm. thick, hyphae below the pellicle hyaline, sparingly branched, 3–5 μ in diameter; tubes unevenly and indistinctly stratified, 2–6 mm. long each season, old tubes usually stuffed, white to Pale Ochraceous-Buff; mouths circular to angular, irregular and of unequal size, 2–3 per mm., white, Pale Ochraceous-Buff to Ochraceous-Buff; dissepiments

[83] Baxter, D. V. *l.c.*

becoming dentate with age, 60–100 μ thick; hymenium 10–15 μ broad, evanescent and often entirely absent; basidia hyaline, 4–7 μ broad; spores hyaline, smooth, ovoid, 4–6 x 3–4 μ; no cystidia observed.

Habitat: various coniferous hosts, especially *Picea Engelmanni;* rare on deciduous hosts.

Distribution: montane and subalpine zones. Widespread in the United States.

Occurrence: rare in Colorado; apparently frequent elsewhere.

Type of rot: white rot.

Although this fungus is of frequent occurrence in the United States, only one collection is known from Colorado. This was made at Cripple Creek, Colorado, on *Picea Engelmanni*, by Humphrey, in 1909. Undoubtedly, additional specimens will be found in later years.

One outstanding characteristic of *Fomes annosus* is the free edges of the annual layers of growth. This characteristic, which can be seen in plate 36, seems to be constant in occurrence. Also, the plant is rather thin for a *Fomes*, never exceeding 2 cm. in thickness.

Conidia production has been known since the time of Brefeld (1889). An illustration of these may be found in Gäumann and Dodge, *l. c.*, p. 446.

LENZITES

Lenzites Fries, Gen. Hymen. p. 10. 1836.

Plants annual or perennial, lignicolous, sessile or effused-reflexed, coriaceous to woody, never putrescent; surface anoderm, usually zonate, tomentose; context white to brown, thin; hymenium disposed on radiating lamellae which at times become more or less transversely anastomosed; spores hyaline, smooth, cylindric, usually curved; cystidia present or absent; no setae.

Members of the genus *Lenzites* are somewhat similar in appearance to those of the gymnocarpous Agaricales, both of which have radiating lamellae or gills. Members of this genus, however, are always coriaceous or woody and never putrescent, whereas members of the Agaricales are usually fleshy and putrescent.

At times, young specimens of this genus may show a poroid or daedaloid condition of the hymenial elements, due to the presence

of transverse dissepiments. These dissepiments, however, usually break down with age, thus producing a true lamellate condition.

KEY TO THE SPECIES

Context white to whitish.....1
Context brown.....2
1. Pileus dark-brown; tubes or lamellae white to whitish...*38. Trametes variiformis*
Pileus gray to cinereous; lamellae brown or purplish.....*6. Polyporus abietinus*
Pileus white to whitish; lamellae white to yellowish..*39. Trametes heteromorpha*
2. Pileus gray, cinereous to gray, never brown, less than 4 mm. thick.
.....*6. Polyporus abietinus*
Pileus yellowish-brown to rusty-brown, more than 4 mm. thick.....3
3. Lamellae or pores large, averaging 1 per mm., usually lamellate from the first.....*55. L. saepiaria*
Lamellae or pores smaller, 1–2 per mm., sometimes poroid to daedaloid
.....*56. L. trabea*

55. Lenzites saepiaria (Wulf.) Fries, Epicr. Myc. p. 407. 1838.
Agaricus hirsutus Schaeff. Fung. Bavar. **1**: *pl. 76.* 1762.
Agaricus saepiarius Wulfen, in Jacq. Coll. **1**: 347. 1786.
Agaricus boletiformis Sow. Col. Figs. Eng. Fung. *pl. 418.* 1814.
Daedalea saepiaria (Wulf.) Fries, Obs. Myc. **1**: 105. 1815.
Lenzites rhabarbarina Berk. & Curt. Ann. & Mag. Nat. Hist. II. **12**: 438. 1853.
Sesia hirsuta (Schaeff.) Murr. Jour. Myc. **9**: 88. 1903.
Gloeophyllum hirsutum (Schaeff.) Murr. Jour. Myc. **9**: 94. 1903. In part.
Gloeophyllum abietinellum Murr. N. Am. Fl. **9**: 129. 1908.
Lenzites abietinella (Murr.) Sacc. & Trott. in Sacc. Syll. Fung. **21**: 126. 1912.

Plate 37, figs. 1–2.

Pileus annual or perennial, flabelliform, dimidiate or conchate, sessile or effused-reflexed, 1–5 x 2–15 x 0.3–1 cm.; surface zonate, strigose, anoderm, uneven, Argus Brown, Bone Brown to almost black; margin even to undulating, at first round, strigose-tomentose, sterile below, Ochraceous-Tawny, with age becoming acute, fertile, concolorous with the surface; context homogeneous to indistinctly zonate, corky, Ochraceous-Tawny, turning with age to Argus Brown, 2–6 mm. thick, hyphae of the context radially arranged, brown under the microscope, sparingly branched,

straight, with few cross walls, thin-walled, 4–6 μ in diameter; lamellae occasionally anastomosing, Light Ochraceous-Buff to Ochraceous-Orange, 0.5–1 mm. broad, 2–10 mm. deep, averaging about 1 per mm., edges at first thick, hirsute, entire, with age becoming thin, glabrous, dentate-lacerate; hymenium hyaline, 22–30 μ broad; basidia hyaline, 4–5 μ in diameter; spores hyaline, smooth, elongate-ellipsoid, occasionally curved, apiculate, 8–10 x 3–4 μ; cystidia small and inconspicuous, hyphae-like with incrusted apexes, projecting up to 10 μ, similar in structure to those of *Polyporus abietinus* (pl. 18, fig. 5).

Habitat: on various conifers; rare on deciduous hosts.

Distribution: widespread in Colorado and the United States.

Occurrence: common. Throughout the year.

Type of rot: brown rot.

This fungus is the most common one found in Colorado. It grows upon all conifers irrespective of altitude, and is occasionally found on aspen (*Populus tremuloides*) and rarely on alder (*fide* Kauffman, *l. c.*, reported as *Lenzites abietinella*). It is easily identified by its brownish pileus with an orange-colored margin, and its thick lamellae.

It was thought by Murrill[84] and others that *Trametes odorata* (*T. protracta*) was the poroid form of this species. However, Snell *et al.*[85] have recently established the validity for separating these two species.

Lenzites abietinella, which was described from plants collected in Colorado, has smaller and more closely set lamellae than is shown in typical specimens of *L. saepiaria* (pl. 37). Intermediate stages, however, have been found, hence this species is considered here as one of the many variants. The European *Lenzites abietina* is also closely related, but due to the presence of ventricose cystidia, it is sufficiently distinct to carry a specific name.

56. Lenzites trabea (Pers.) Fries, Epicr. Myc. p. 406. 1838.
Agaricus trabeus Pers. Syn. Fung. **1**: xxix. 1801.
Daedalea trabea (Pers.) Fries, Syst. Myc. **1**: 335. 1821.
Lenzites vialis Peck, Ann. Rept. N. Y. State Mus. **26**: 67. 1874.

[84] Murrill, W. A. Mycologia **12**: 15. 1920.
[85] Snell, W. H. *et al.* Mycologia **20**: 276–291. 1928.

Sesia pallidofulva Murr. Bull. Torr. Bot. Club **31**: 605. 1904.
Gloeophyllum pallidofulvum Murr. *ibid.* **32**: 370. 1905.
Gloeophyllum trabeum (Pers.) Murr. N. Am. Fl. **9**: 129. 1908.

Plate 38, fig. 1.

Pileus coriaceous, sessile, effused-reflexed, occasionally resupinate, dimidiate, laterally connate, 1–4 x 1–7 x 0.2–1.5 cm.; surface tomentose to nearly glabrous, smooth to tuberculate, zonate, Sayal Brown, Cinnamon-Brown to Mummy Brown; margin entire to undulating, obtuse, tomentose, concolorous to lighter, sterile below; context soft-corky, Sayal Brown to Cinnamon-Brown, homogeneous, with age becoming indistinctly multizonate and duplex, the layer adjacent to the tubes lighter-colored and firmer, 1–6 mm. thick, hyphae of the context of two kinds: hyaline hyphae 2–3 μ in diameter, and brown hyphae 4–6 μ in diameter; tubes or lamellae concolorous with the context, fulvous lined, 2–12 mm. long; mouths poroid, daedaloid, labyrinthiform, or radially elongate to lamellate, 1–2 per mm., Ochraceous-Tawny to Cinnamon-Brown; dissepiments undulating, dentate to lacerate, often torn, usually very thin, 40–80(150) μ thick; hymenium hyaline, 16–25(35) μ broad; basidia hyaline, 4–6 μ in diameter, usually projecting up 20 μ beyond the level of the hymenium; spores hyaline, smooth, cylindric to elongate-ellipsoid, apiculate, 8–12 × 3–4.5 μ; no cystidia observed.

Habitat: on both coniferous and deciduous hosts, especially cottonwoods (*Populus* spp.).

Distribution: plains and foothill zones. Northeastern United States and the Rocky Mountain region.

Occurrence: uncommon. Spring and summer.

Type of rot: brown rot.

This fungus may be found in all stages of development from a typical poroid to a typical lamellate condition, hence identification at times is bothersome. The poroid form may be confused with *Trametes odorata*, and the lamellate form with *Lenzites saepiaria;* but in the latter two species, the dissepiments are nearly 1 mm. thick, whereas those of *L. trabea* are paper-thin.

FAVOLUS

Favolus Beauv. Fl. Oware 1: 1. *pl. 1.* 1805.

Plants annual, lignicolous, fleshy-tough when fresh; stipe short, lateral, rarely excentric, rarely sessile; context white, thin; pore-mouths large, angular, alveolar, radially elongated, often radially arranged; spores hyaline; no cystidia.

The members of this genus are characterized by the presence of large radially elongated pores, which are usually radially arranged, and the lateral short stipe. The genus differs from *Hexagona* in that the pores of specimens of the latter genus are hexagonal or honey-comb-like in structure. Furthermore, *Hexagona* is a tropical genus, whereas *Favolus* is both tropical and temperate in distribution.

57. Favolus alveolaris (DC.) Quél. Ench. Fung. p. 185. 1886.
Merulius alveolaris DC. Fl. Fr. 6: 43. 1815.
Hexagona Mori Pollini, Pl. Nov. p. 35. 1816.
Cantharellus alveolaris (DC.) Fries, Syst. Myc. 1: 322. 1821.
Boletus arcularius Schw. Schr. Nat. Ges. Leipzig 1: 95. 1822. Not *Boletus arcularius* Batsch. 1783.
Favolus canadensis Klotzsch, Linnaea 7: 197. 1832.
Favolus europaeus Fries, Epicr. Myc. p. 498. 1838.
Polyporus Boucheanus peponinus Berk. & Curt. Ann. & Mag. Nat. Hist. II. 12: 432. 1853.
Favolus ohiensis Berk. & Mont.; Mont. Syll. Crypt. p. 171. 1856.
Favolus striatulus Ellis & Ev. Am. Nat. 31: 339. 1897.
Hexagona alveolaris (DC.) Murr. Bull. Torr. Bot. Club 31: 327. 1904.
Hexagona micropora Murr. *ibid.* 328.
Hexagona striatula (Ellis & Ev.) Murr. N. Am. Fl. 9: 48. 1907.

Plate 38, fig. 5.

Pileus reniform, flabelliform to circular, convex-plane, depressed behind, fleshy-tough when fresh, drying brittle, 1–4 x 1–8 x 0.2–0.7 cm.; surface at first strigose-squamose, Mars Yellow to Ochraceous-Tawny, at length almost glabrous and fading to Light

Buff; margin at first thin, entire, incurved, at length becoming thicker, undulating to lobed, concolorous, or as dark as Chestnut-Brown; context homogeneous, 0.5–2 mm. thick, white in fresh plants, drying Light Buff to Ochraceous-Tawny, hyphae of the context hyaline under the microscope, branched, 3–5 μ in diameter; tubes decurrent, at first white to Light Buff, drying Light Vinaceous-Cinnamon to Russet, 1–5 mm. long; mouths concolorous, radially elongated, 2–5(10) mm. long, 1–2.5 mm. broad, radially arranged; dissepiments thin, often torn so that the pores are confluent and lamellae-like, dentate, 150–400 μ thick; stipe lateral, rarely excentric, short, usually a lateral tubercle, 2–8 mm. thick, 1–12 mm. long, concolorous with the surface of the pileus; hymenium hyaline, compact, 22–26 μ broad; basidia hyaline, 6–8 μ in diameter; spores smooth, hyaline, elongate-ellipsoid, apiculate, occasionally curved, 9–12 x 3–4.5 μ; no cystidia.

Habitat: on various deciduous hosts.

Distribution: foothill zone. Northern half of the United States and west as far as Montana and Colorado.

Occurrence: rare. Spring.

Type of rot: white rot.

Only a single collection of this fungus, made by E. Bethel, on choke cherry, near Boulder, Colorado, is known from Colorado.

The plant is characterized by its short lateral stipe and radially elongated pores. *Polyporus arcularius* may at times have radially elongated pores, but it differs from this species in having a central stipe and a ciliated margin.

In most of the American and foreign literature, this plant is named *Favolus europaeus*, or *F. canadensis*. The departure from "usage" is made in order to comply with the International Rules.

PORIA

Poria Pers. Neues Mag. Bot. **1**: 109. 1794.

Plants annual or perennial, lignicolous, resupinate, separable or inseparable; margin thin or thick, fertile or sterile; pores circular to daedaloid; spores variously shaped and colored; setae or cystidia present or absent.

The genus *Poria* contains all persistently resupinate members

of the family Polyporaceae. One occasionally finds species of *Polyporus*, *Trametes*, and *Fomes* which under unusual conditions complete their cycle of growth in a resupinate growth-form. This has lead to the description of several species of *Poria* which are only resupinate growth-forms of pileate species. For example, *Poria callosa* is *Trametes serialis*, and *Poria obducens* is *Fomes connatus*.

KEY TO THE SPECIES

Sporophores light-colored, as: white, cream, or yellow.....1
Sporophores dark-colored, as: brown, purple, or red.....4
1. Sporophores with a brownish-colored, sterile margin which is more than 1 mm. thick.....*58. P. monticola*
Sporophores with variously colored, sterile margins which are less than 1 mm. thick, or margins entirely fertile.....2
2. Margin either sterile to a breadth of 1 mm. or less, or else entirely fertile .....*59. P. vaporaria*
Margin usually sterile to a breadth of more than 1 mm.....3
3. Growing mainly on deciduous wood.....*60. P. medulla-panis*
Growing mainly on coniferous wood.....*61. P. subacida*
4. Sporophores some shade of red.....*62. P. spissa*
Sporophores some shade of purple.....*63. P. purpurea*
Sporophores ferruginous in color.....5
5. Spores 4.5–5 x 2–3 μ.....*64. P. ferruginosa*
Spores 6–9 x 2 μ.....*36. Trametes isabellina*

58. Poria monticola Murr. Mycologia 12: 90. 1920.

Plate 38, fig. 4.

Sporophores widely effused, inseparable, 1–6 mm. thick; margin sometimes thin, fimbriate to membranous, fertile, more frequently thick, sterile, hirsute, darker than the pores, Prout's Brown, Mummy Brown to Blackish Brown; subiculum less than 1 mm. thick, white to Cartridge Buff, hyphae hyaline under the microscope, branched, with few septa, very thick-walled, 3–4 μ in diameter; tubes 1–5 mm. long, often oblique and laterally opened, at first white, with age and on drying becoming Light Buff to Warm Buff; mouths angular to elongate, averaging 2–3 per mm., at first white, drying Light Buff to Warm Buff, brownish and translucent where bruised; dissepiments entire to dentate, 75–150 μ thick; hymenium hyaline under the microscope, 12–16 μ broad; basidia hyaline, 5–7 μ in diameter; spores hyaline, smooth, elongate-ellipsoid, occasionally curved, 5–7 x 2–3 μ; no cystidia observed.

Habitat: on both coniferous and deciduous hosts.

Distribution: montane zone. Known from Idaho and Colorado.

Occurrence: rare. Summer and autumn.

Type of rot: white rot.

This *Poria* is characterized by having a thick, dark-brown, sterile margin which gives the impression that the fruiting body is slightly reflexed.

59. Poria vaporaria (Fr.) Cooke, Grevillea **14**: 111. 1886. Not *Poria vaporaria* Pers. 1797.

Polyporus vaporaria Fries, Obs. Myc. **2**: 260. 1818; Syst. Myc. **1**: 382. 1821.

Boletus incertus Pers. Myc. Eur. **2**: 106. 1825.

Poria incerta (Pers.) Murr. Mycologia **12**: 78. 1920.

Plate 39, fig. 2.

Sporophores widely effused, inseparable, the white floccose mycelium penetrating into the wood and perceptible to the unaided eye, 0.5–1.5 mm. thick; margin at first sterile to a breadth of 1 mm. or less, white, floccose, with age becoming fertile; subiculum less than 1 mm. thick, apparently absent in old specimens; tubes 0.5–1.5 mm. long, often oblique, at first white, with age and on drying turning Pinkish Buff, Warm Buff to Cinnamon-Buff, tubes often splitting apart in uneven lines and revealing the floccose underlying subiculum; mouths concolorous, circular to angular, never daedaloid, unequal, averaging 2–4 per mm.; dissepiments with age becoming denticulate; hyphae of the trama hyaline, nodose-septate, 2–3 μ in diameter; basidia 4–5 μ broad; spores hyaline, smooth, allantoid, 4–6 x 1–2 μ; no cystidia.

Habitat: on various coniferous and deciduous hosts.

Distribution: montane zone. Widespread in the United States.

Occurrence: rare. Autumn.

Type of rot: brown rot.

Only a single collection of this fungus is reported from Colorado. This was made by Seaver and Bethel at Tolland, Colorado, in 1910, and identified by Murrill. The writer has drawn the above description from this collection, and it agrees in its essential characters with the description of *Poria vaporaria* by Bourdot and Galzin.[86]

[86] Bourdot, H. & A. Galzin. Hymen. Fr. **1**: 673. 1927.

There seems to be some confusion in the identity of this plant. Bourdot and Galzin (*l. c.*) state: "Cette plante n'est pas le *P. vaporaria* Pers. qui, d'après M. Bresadola, représenterait vraisemblablement le *P. Vaillantii* Fr.—La spore que figure Quélet (Ass. fr., 1891, f. 25) pour *P. vaporaria* est celle de *P. mucida* Pers. et, c'est sur des formes de cette dernière espèce, que tombaient toutes les déterminations qu'il nous a données de *P. vaporaria.* Cette interprétation de Quélet est du reste presque universellement suivie en France et en Angleterre." Murrill[87] has expressed somewhat the same idea as that just stated.

60. Poria medulla-panis (Jacq.) Pers. Neues Mag. Bot. **1**: 109. 1794; Syn. Myc. **2**: 544. 1801.

Boletus medulla-panis Jacquin, Misc. Austr. p. 141. *pl. 11.* 1778.

Polyporus medulla-panis (Jacq.) Fries, Syst. Myc. **1**: 380. 1821.

Polyporus xantholoma Schw. Trans. Am. Phil. Soc. II. **4**: 158. 1832.

Poria xantholoma (Schw.) Cooke, Grevillea **14**: 113. 1886.

Plate 39, fig. 4.

Sporophores annual or perennial, inseparable, 1–8 mm. thick, 5–30 cm. or more long; subiculose margin at first sterile to a breadth of 0.5–3 mm., obtusely rounded, thick, undulating, tomentose, Cream Color to Chamois, with age becoming fertile, acute, and as dark as Honey Yellow; subiculum less than 1 mm. thick, white to pallid, hyphae hyaline to yellow under the microscope, much branched and interwoven, incrusted, 1.5–3(5) μ in diameter; tubes indistinctly stratified, often oblique, the older layers white-stuffed, 0.5–3 mm. long each season; mouths concolorous with the margin, with age fading to almost white, circular to angular, 3–5 per mm.; large crystalline bodies often abundant in the trama, hyphae of the trama yellowish under the microscope; basidia hyaline, 5–8 μ in diameter; spores hyaline, smooth, broadly ellipsoid, occasionally truncate, 4–7 x 3–5 μ; no typical cystidia observed.

[87] Murrill, W. A. Mycologia **12**: 78. 1920.

Habitat: on various deciduous hosts.

Distribution: foothill zone to subalpine zone. Widespread in the United States.

Occurrence: common. Summer and autumn.

Type of rot: white rot.

Poria medulla-panis and *P. subacida* are both yellowish-colored and have similar hymenial structures. They may be conveniently separated as follows: *P. medulla-panis* is found only on deciduous hosts, it has a thick sterile margin, and the hyphae of the subiculum are much branched, interwoven, and thin. *P. subacida* is found only on coniferous hosts; it has a thin sterile margin, and the hyphae of the subiculum are thick-walled and apparently unbranched.

61. Poria subacida (Pk.) Sacc. Syll. Fung. **6**: 325. 1888.

Polyporus subacida Peck, Ann. Rept. N. Y. State Mus. **38**: 92. 1885.

Plate 39, fig. 3.

Sporophores annual or perennial, separable to inseparable, 1–20 mm. thick, extended to a distance of 1 meter or more; subiculose margin at first sterile to a breadth of 0.5–6 mm., tomentose, irregular to arachnoid, acute, thin, Light Buff, Pinkish Buff to Ochraceous-Buff, with age becoming fertile; subiculum less than 1 mm. thick, concolorous with the margin, hyphae hyaline to yellowish under the microscope, apparently unbranched and aseptate, very thick-walled, 4–6 μ in diameter; tubes at length stratified, often oblique, the older layers white-stuffed, 2–6 mm. long each season; mouths circular to angular, 3–4 per mm., Cinnamon Buff to Clay Color; large crystalline bodies often abundant in the trama, hyphae of the trama yellowish under the microscope; basidia hyaline, 5–8 μ in diameter; spores hyaline, smooth, broadly ellipsoid, sometimes apiculate, 4–7 x 3–5 μ; no typical cystidia observed.

Habitat: on various coniferous hosts.

Distribution: foothill zone to subalpine zone. Widespread in the United States.

Occurrence: common. Summer and autumn.

Type of rot: white rot.

Compare with the preceding species, *Poria medulla-panis*.

62. Poria spissa (Schw.) Cooke, Grevillea **14**: 110. 1886.

Polyporus spissus Schw. in Fries, Elench. Fung. p. 111. 1828.

Polyporus salmonicolor Berk. & Curt. Hook. Jour. Bot. **1**: 104. 1849; Grevillea **1**: 53. 1872.

Polyporus laetificus Peck, Ann. Rept. N. Y. State Mus. **38**: 91. 1885.

Poria laetifica (Pk.) Sacc. Syll. Fung. **6**: 300. 1888.

Poria salmonicolor (Berk. & Curt.) Sacc. *ibid.* 318.

Plate 39, fig. 1.

Sporophores annual or perennial, inseparable to separable, 2–10 cm. broad, 3–50 cm. or more long, 1–6 mm. thick; subiculose margin arachnoid, tomentose, sterile to a breadth of 6 mm., at first whitish or yellowish, with age and on drying becoming as dark as Pecan Brown, hyphae of the margin yellowish-brown under the microscope, incrusted, 2–4 μ in diameter; subiculum less than 1 mm. thick, apparently absent in old specimens; tubes at length stratified, 0.5–1.5 mm. long each season, occasionally oblique; mouths circular to angular, 4–6 per mm., at first whitish to pale-salmon, with age and on bruising becoming reddish-brown, drying Orange-Cinnamon, Kaiser Brown, Bone Brown to Aniline Black; dissepiments entire, 30–50 μ thick, frequently containing large diamond-shaped crystals 12–15 μ broad and 30–40 μ long which may project beyond the level of the hymenium; spores smooth, hyaline, allantoid, 4–5 x 1–1.5 μ; no cystidia.

Habitat: on deciduous and coniferous hosts.

Distribution: montane and subalpine zones. Widespread in the United States.

Occurrence: rare. Autumn.

Type of rot: white rot.

The reddish color of the mouths and the sterile light-colored margin of this fungus are the outstanding characteristics. The color of young growing specimens is dilute red, which with age becomes darker. Dried specimens show a parallel variation in color from brownish-red to blackish-red, depending upon the age of the fungus when collected.

Only two collections of this species are known from Colorado; these were made by Kauffman at Tolland, Colorado, on the bark of pine and spruce.

63. Poria purpurea (Fr.) Cooke, Grevillea **14**: 112. 1886.
Polyporus purpurea Fries, Syst. Myc. **1**: 379. 1821.

Sporophores round, oblong, or effused for a distance of 30 cm. or more, inseparable, very thin, 0.5–2 mm.; margin at first white to yellowish, arachnoid, with age remaining sterile but changing to a reddish-purple color; subiculum very thin, 0.9–0.5 mm. thick, reddish-purple; tubes at first merulioid, with age becoming 0.5–2 mm. long; mouths circular to angular, unequal, averaging 3–5 per mm., at first yellowish in color, with age becoming brownish-purple to rose-purple, as: Purplish Vinaceous to Vinaceous Brown; hyphae of the trama slightly colored under the microscope, of varying diameters, 2–8 μ in diameter, thin-walled, incrusted; basidia hyaline, 3–6 μ in diameter; spores hyaline, smooth, allantoid 5–8 x 1.5–2.5 μ; no cystidia observed.

Habitat: on various deciduous hosts; probably also on conifers.

Distribution: montane and subalpine zones. Widespread in the United States.

Type of rot: white rot.

This fungus is characterized by its purplish color and allantoid spores. *Poria violacea*, which is reported to be extremely rare,[88] likewise is purplish in color, but differs from *P. purpurea* in having pores which average 2 per mm., and in having ovoid to ellipsoid spores measuring 5 x 2.5–3 μ.

64. Poria ferruginosa (Schrad.) Pers. Syn. Fung. p. 544. 1801.
Boletus ferruginosus Schrad. Spic. Fl. Germ. p. 172. 1794.
Polyporus ferruginosus (Schrad.) Fries, Syst. Myc. **1**: 378. 1821.
Polyporus Macouni Peck, Bot. Gaz. **4**: 169. 1879.
Fuscoporia ferruginosa (Schrad.) Murr. N. Am. Fl. **9**: 5. 1907.
Poria Macouni (Pk.) Overh. N. Y. State Mus. Rept. **71**[2]: 86. 1917.

Plate 39, fig. 5.

Sporophores annual or perennial, woody, effused for a distance of 1 meter, 0.5–6 mm. thick, inseparable; subiculose margin entire to undulating, at first sterile to a breadth of 5 mm., tomentose, Ochraceous-Tawny, with age becoming fertile and thin or imbri-

[88] Murrill, W. A. Mycologia **13**: 92. 1921.

cate-subpileate when growing on an irregular substratum; subiculum usually less than 1 mm. thick, Ochraceous-Tawny, hyphae apparently unbranched and aseptate, brownish under the microscope, 2–3 μ in diameter; tubes eventually stratified, often oblique, 1–6 mm. long each season, fulvous within; mouths circular to angular, averaging 4–6 per mm., Cinnamon, Sayal Brown to Snuff Brown; dissepiments entire, 40–80 μ thick; hymenium hyaline under the microscope, 8–12 μ broad; basidia hyaline, 4-spored, 4.5–6 μ in diameter; spores hyaline, smooth, ellipsoid, 4.5–5 x 2–3 μ; setae abundant, pointed, projecting 20–30(40) μ beyond the general level of the hymenium, 5–7 μ broad at their bases, similar in shape to those of *Trametes isabellina* (pl. 30, fig. 1).

Habitat: on various deciduous hosts; rare on conifers.

Distribution: foothill zone to subalpine zone. Widespread in the United States.

Occurrence: rare. Summer and Autumn.

Type of rot: white rot.

Poria ferruginosa may be differentiated from resupinate specimens of *Trametes isabellina* as follows: the spores of the former species are 4.5–5 x 2–3 μ and the setae project up to 30 μ; whereas the spores of the latter species are 6–9 x 2 μ and the setae project up to 50 μ.

This fungus is very common in eastern United States where deciduous trees predominate. However, in the Rocky Mountain region, where coniferous trees predominate, it is of rare occurrence.

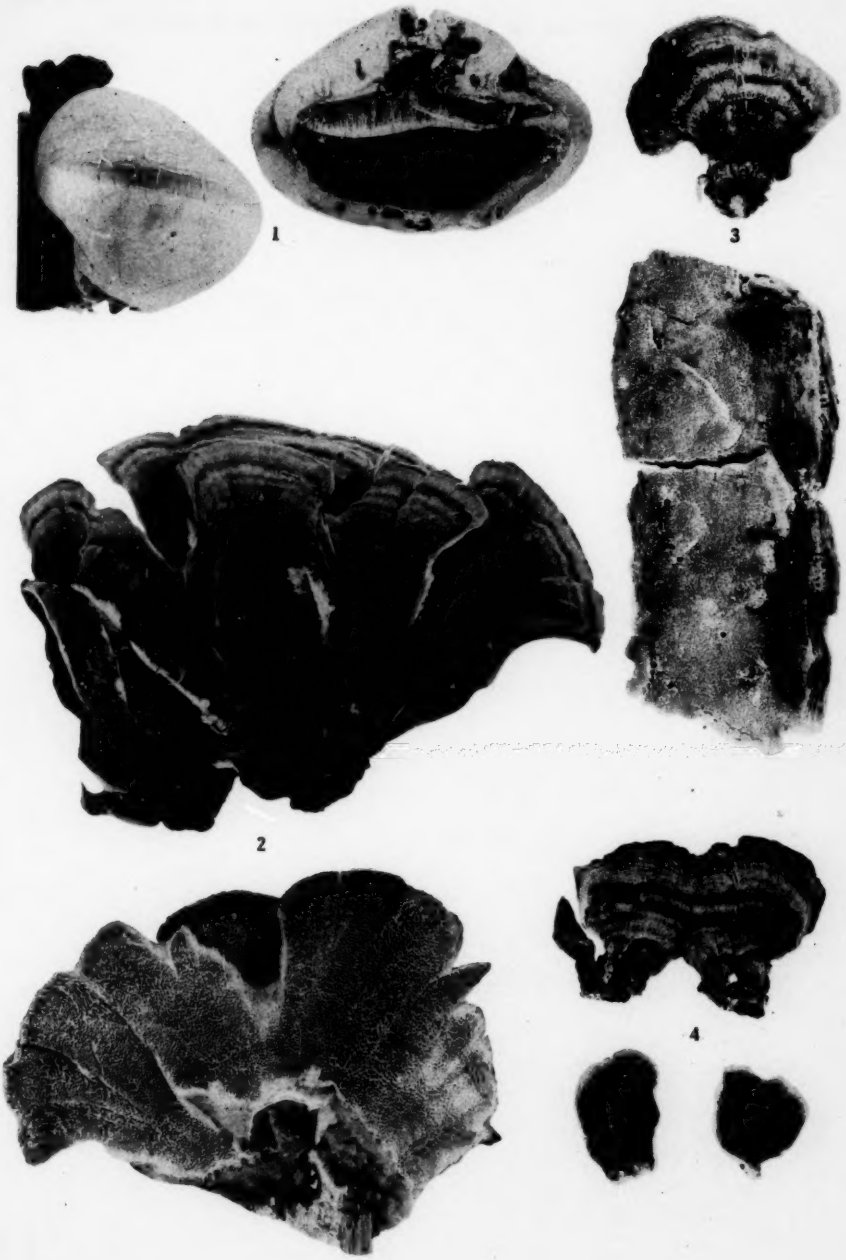
Index to Species

Synonyms are printed in *italics*, previously published specific names in ordinary type, and genus names in CAPITALS. Pages on which genera and species are described are printed in **bold face** type.

Explanation of Plate

PLATE 16

Fig. 1. *Polyporus volvatus* Pk. × 1. Habit and section views.
Fig. 2. *Polyporus versicolor* (L.) Fr. × 1. Upper and lower surfaces.
Fig. 3. *Polyporus zonatus* Fr. × 1. Upper and lower surfaces.
Fig. 4. *Polyporus pargamenus* Fr. × 1. Upper and lower surfaces.



SHOPE — POLYPORACEAE OF COLORADO

COCKAYNE, BOSTON

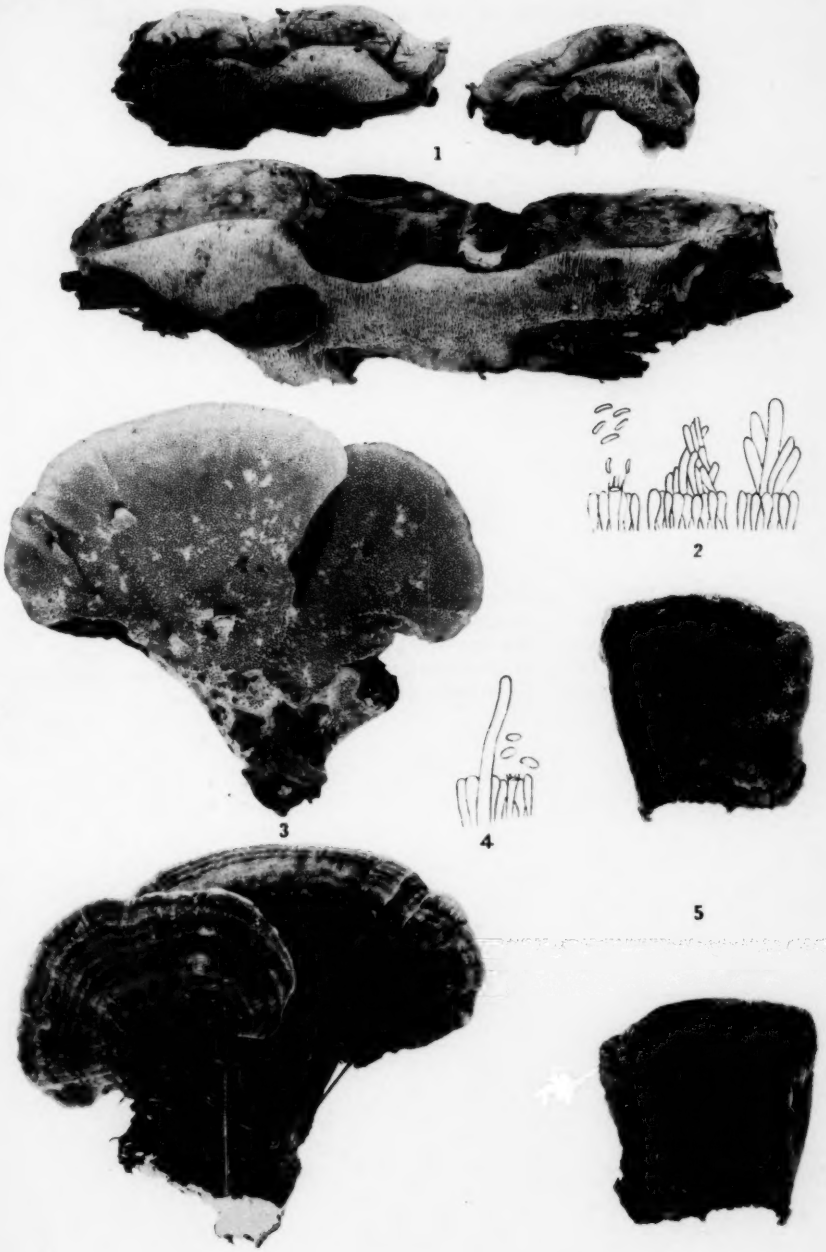
Explanation of Plate

PLATE 17

Figs. 1–2. *Polyporus leucospongia* Cooke & Hark. Fig. 1 shows three sporophores × 1. Fig. 2 shows a basidium, spores, and hyphal pegs. × 450.

Fig. 3. *Polyporus hirsutus* (Wulf.) Fr. × 1. Upper and lower surfaces.

Figs. 4–5. *Polyporus fibrillosus* Karst. Fig. 4 shows a basidium, spores, and a cystidium. × 450. Fig. 5 shows the upper and lower surfaces. × 1.



SHOPE — POLYPORACEAE OF COLORADO

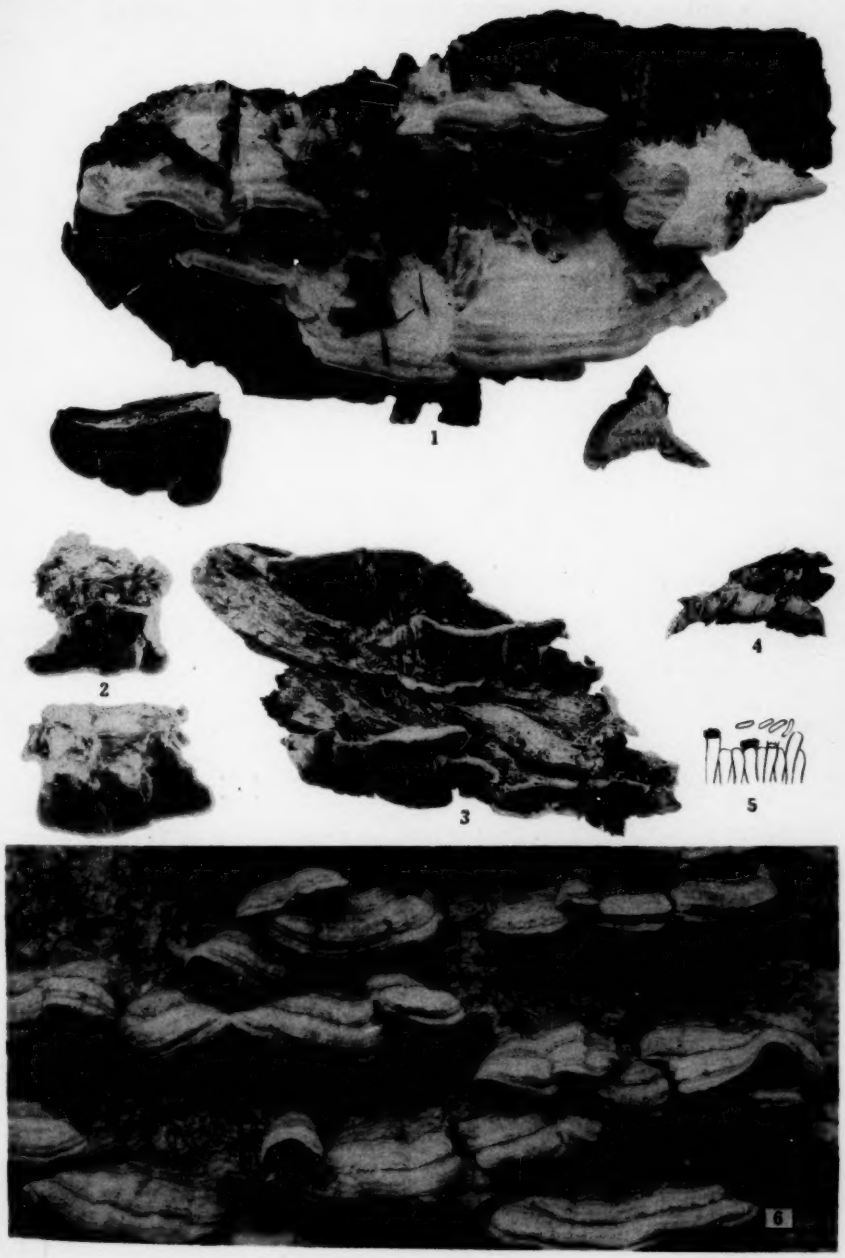
COCKAYNE, BOSTON

Explanation of Plate

PLATE 18

Fig. 1. *Polyporus subchartaceus* (Murr.) Overh. × 1. Habit, pore layer, and section views.

Figs. 2–6. *Polyporus abietinus* (Dicks.) Fr. The poroid and lamellate hymenia are shown in figs. 2 and 3 respectively; fig. 4 shows a vertical section, and fig. 6 a habit view. × 1. Fig. 5 shows a basidium, spores, and incrusted and smooth cystidia. × 450.



SHOPE — POLYPORACEAE OF COLORADO

COCKAYNE, BOSTON

Explanation of Plate

PLATE 19

Figs. 1–4. *Polyporus alboluteus* Ell. & Ev. Figs. 1–3 show section views and front view. × 1. Fig. 4 shows a cystidium and spores. × 450.

Figs. 5–8. *Polyporus ursinus* Lloyd. Figs. 5 and 6 show saturated and air-dry halves of a single sporophore; fig. 7 shows upper and lower surfaces. × 1. Fig. 8 shows basidia, spores, and incrusted cystidia. × 450.

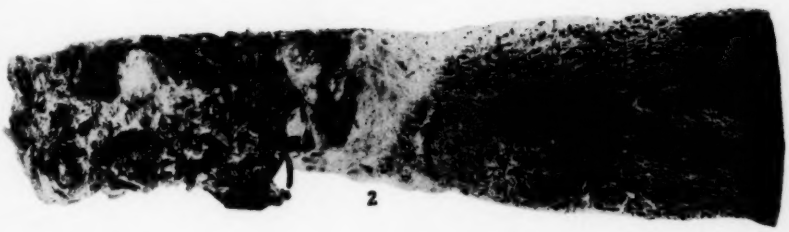
SHOPE — POLYPORACEAE OF COLORADO

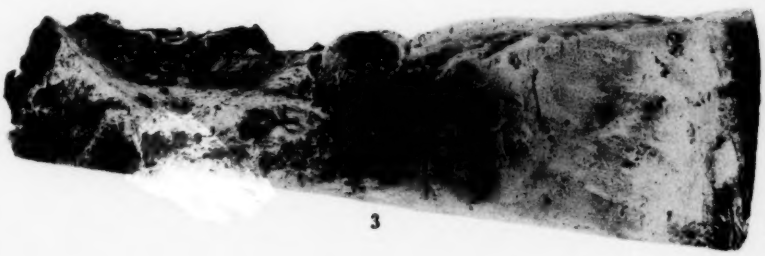
COCKAYNE, BOSTON

Explanation of Plate

PLATE 20

Figs. 1–4. *Polyporus borealis* Fr. Figs. 1–3 show vertical section, pore layer, and upper surface. × 1. Fig. 4 shows spores and cystidia. × 450.





SHOPE — POLYPORACEAE OF COLORADO

COCKAYNE, BOSTON

Explanation of Plate

PLATE 21

Figs. 1–4. *Polyporus adustus* (Willd.) Fr. × 1. Figs. 1 and 3 show the pore layers of young and old sporophores; fig. 2 habit view, and fig. 4 vertical sections.

Figs. 5–6. *Polyporus Rheades* (Pers.) Fr. × 1. Fig. 5 shows small aspen form; fig. 6 shows large oak form with a large central core.

SHOPE — POLYPORACEAE OF COLORADO

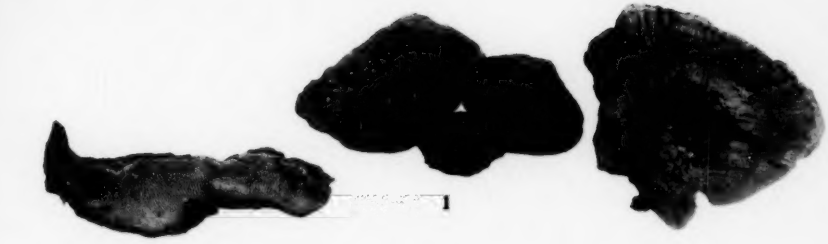
COCKAYNE, BOSTON

Explanation of Plate

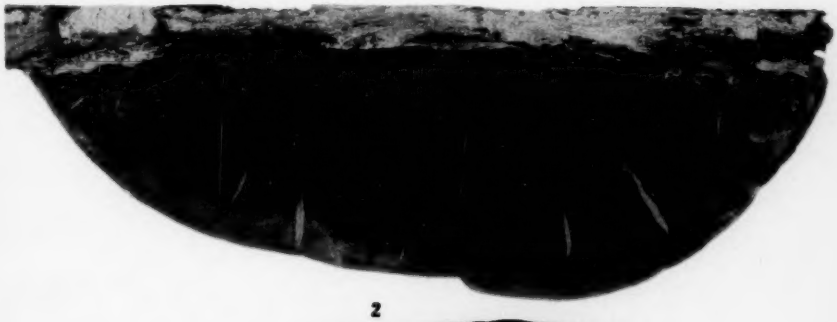
PLATE 22

Fig. 1. *Polyporus planellus* (Murr.) Overh. × 1. Three sporophores showing upper and lower surfaces.

Fig. 2. *Polyporus resinosus* (Schrad.) Fr. × 1. Upper and lower surfaces and vertical section are shown.



1



2

SHOPE — POLYPORACEAE OF COLORADO

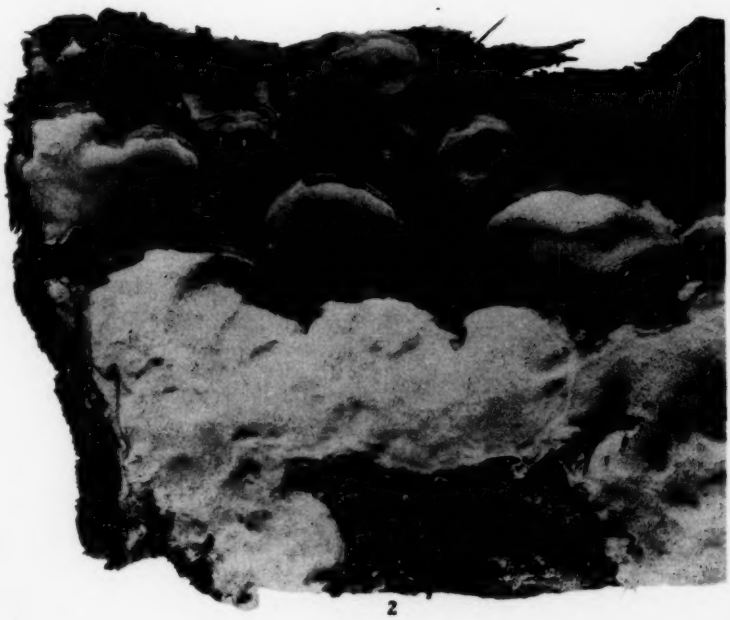
COCKAYNE, BOSTON

Explanation of Plate

PLATE 23

Fig. 1. *Polyporus crispus* (Pers.) Fr. × 1. The imbricate growth-form is shown in the upper left photograph; to the right are shown the pore layer and section views.
Fig. 2. *Polyporus anceps* Pk. × 1. Habit view.

1



2

SHOPE — POLYPORACEAE OF COLORADO

COCKAYNE, BOSTON

Explanation of Plate

PLATE 24

Fig. 1. *Polyporus cinnabarinus* (Jacq.) Fr. × 1. Upper and lower surfaces.

Fig. 2. *Polyporus ovinus* (Schaeff.) Fr. × 1. Photograph by C. G. Lloyd, courtesy of the Smithsonian Institution.

Fig. 3. Three views of *Polyporus cinnamomeus* (Jacq.) Fr. × 1.

Fig. 4. *Polyporus fragilis* Fr. × 1. Upper surface.

Figs. 5–6. *Polyporus arcularius* (Batsch) Fr. Fig. 5 shows habit view. × 1. Fig. 6 shows gelatinized hyphal peg in which the individual hyphae are scarcely discernible. × 450.

SHOPE — POLYPORACEAE OF COLORADO

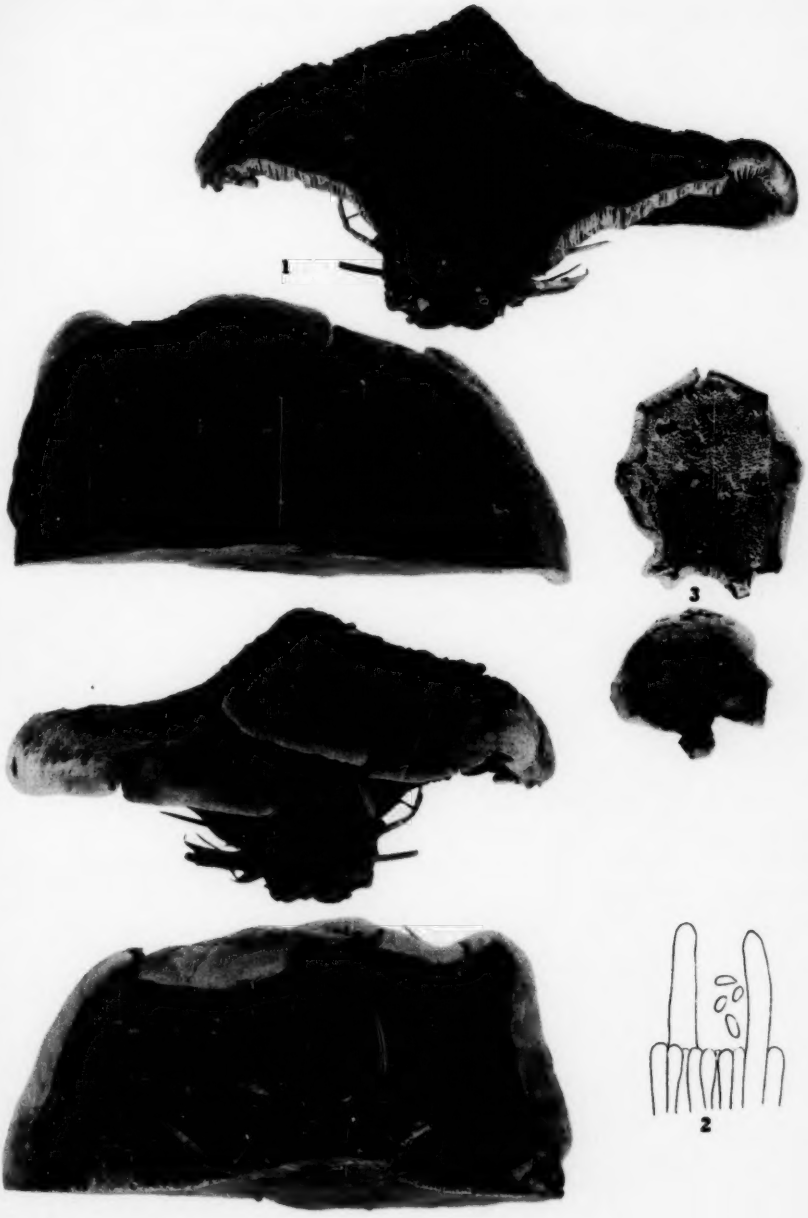
COCKAYNE, BOSTON

Explanation of Plate

PLATE 25

Figs. 1–2. *Polyporus Schweinitzii* Fr. Fig. 1 shows four different views. × 1. Fig. 2 shows spores and cystidia. × 450.

Fig. 3. *Polyporus cryptopus* Ell. & Barth. Upper and lower surfaces. × 1.



SHOPE — POLYPORACEAE OF COLORADO

COCKAYNE, BOSTON

Explanation of Plate

PLATE 26

Figs. 1–2. *Polyporus circinatus* Fr. Fig. 1 shows four sporophores, two of which are shown in vertical section. × 1. Fig. 2 shows a seta and spores. × 450.

Fig. 3. *Polyporus perennis* (L.) Fr. × 1. Five sporophores are shown of which one is in vertical section.

SHOPE — POLYPORACEAE OF COLORADO

COCKAYNE, BOSTON

Explanation of Plate

PLATE 27

Figs. 1–2. *Polyporus elegans* (Bull.) Fr. × 1. Fig. 1 shows the upper and lower surfaces of old and weathered sporophores; fig. 2 shows young sporophores.

Fig. 3. *Polyporus hirtus* Quél. × 1. Vertical-section and pore-surface views are shown.

Figs. 4–7. *Polyporus varius* (Pers.) Fr. Young sporophores are shown in various views.

SHOPE — POLYPORACEAE OF COLORADO

COCKAYNE, BOSTON

Explanation of Plate

PLATE 28

Fig. 1. *Polyporus confluens* (Alb. & Schw.) Fr. × 1. Pore-surface and vertical-section views are shown.

Fig. 2. *Polyporus spumeus* (Sow.) Fr. × 1. Vertical-section and pore-surface views are shown.

Fig. 3. *Polyporus caesius* (Schrad.) Fr. × 1. Upper- and lower-surface views are shown.

Figs. 2–3 are from photographs by L. O. Overholts.

SHOPE — POLYPORACEAE OF COLORADO

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Explanation of Plate

PLATE 29

Figs. 1–2. *Polyporus squamosus* (Huds.) Fr. Fig. 1 shows a habit view. × ½. Fig. 2 shows the pore surface and stipe. × 1.

Fig. 3. *Polyporus osseus* Kalchbr. × 1. Photograph by C. G. Lloyd, courtesy of the Smithsonian Institution.

Figs. 4–6. *Fomes roseus* (Alb. & Schw.) Cooke. × 1. Surface, pore-layer, and vertical-section views are shown.


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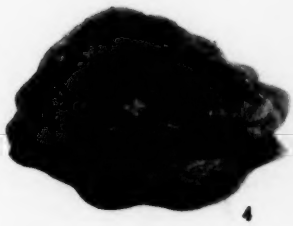
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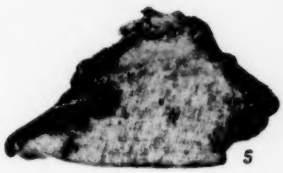
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SHOPE — POLYPORACEAE OF COLORADO

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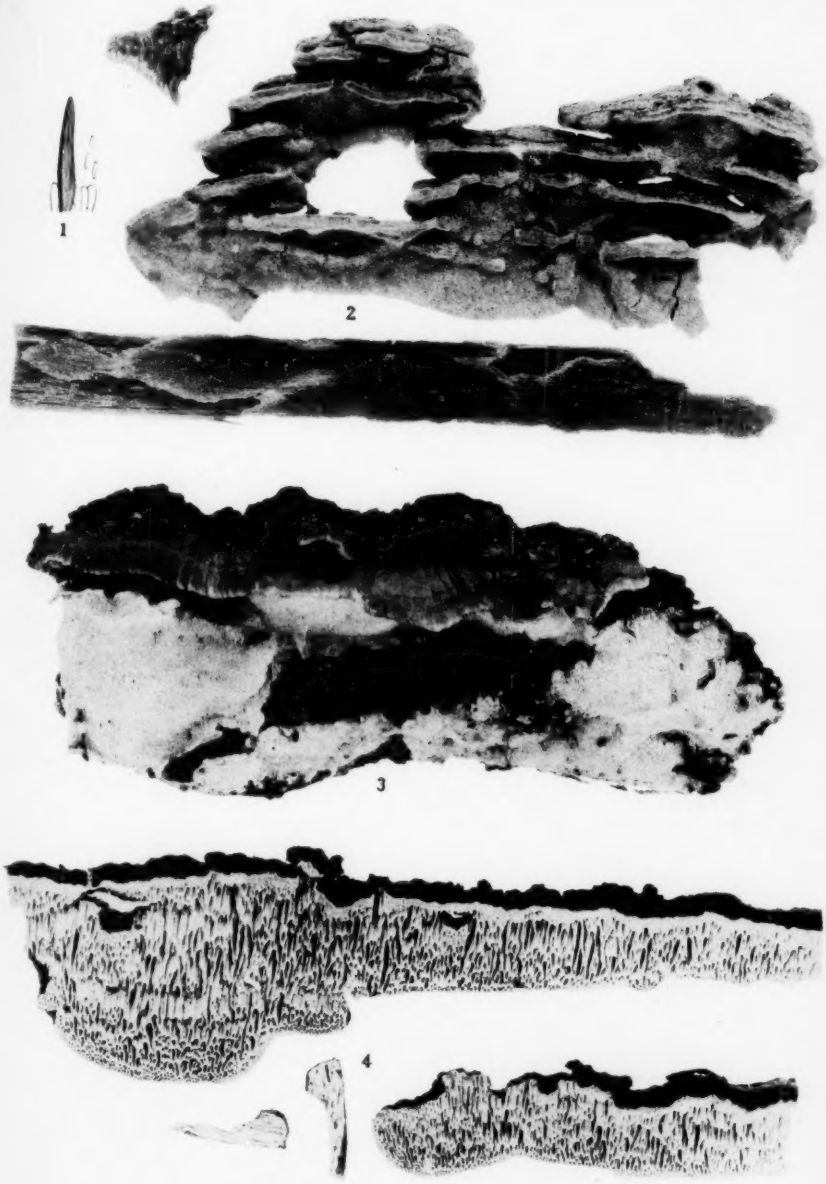
Explanation of Plate

PLATE 30

Figs. 1–2. *Trametes isabellina* Fr. Fig. 1 shows a seta and spores. × 450. Fig. 2 shows imbricate and sessile growth-forms. × 1.

Fig. 3. Habit view of *Trametes serialis* Fr. × 1.

Fig. 4. *Trametes variiformis* Pk. × 1.



SHOPE — POLYPORACEAE OF COLORADO

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Explanation of Plate

PLATE 31

Fig. 1. *Trametes stereoides* (Fr.) Bres. × 1. Upper and lower surfaces and vertical section are shown.

Fig. 2. Habit view of *Trametes heteromorpha* (Fr.) Lloyd. × 1.

Fig. 3. *Trametes hispida* Pass. × 1. Upper and lower surfaces and vertical section are shown.

Fig. 4. *Trametes odorata* (Wulf.) Fr. × 1. Upper and lower surfaces and vertical section are shown.

SHOPE — POLYPORACEAE OF COLORADO

COCKAYNE, BOSTON

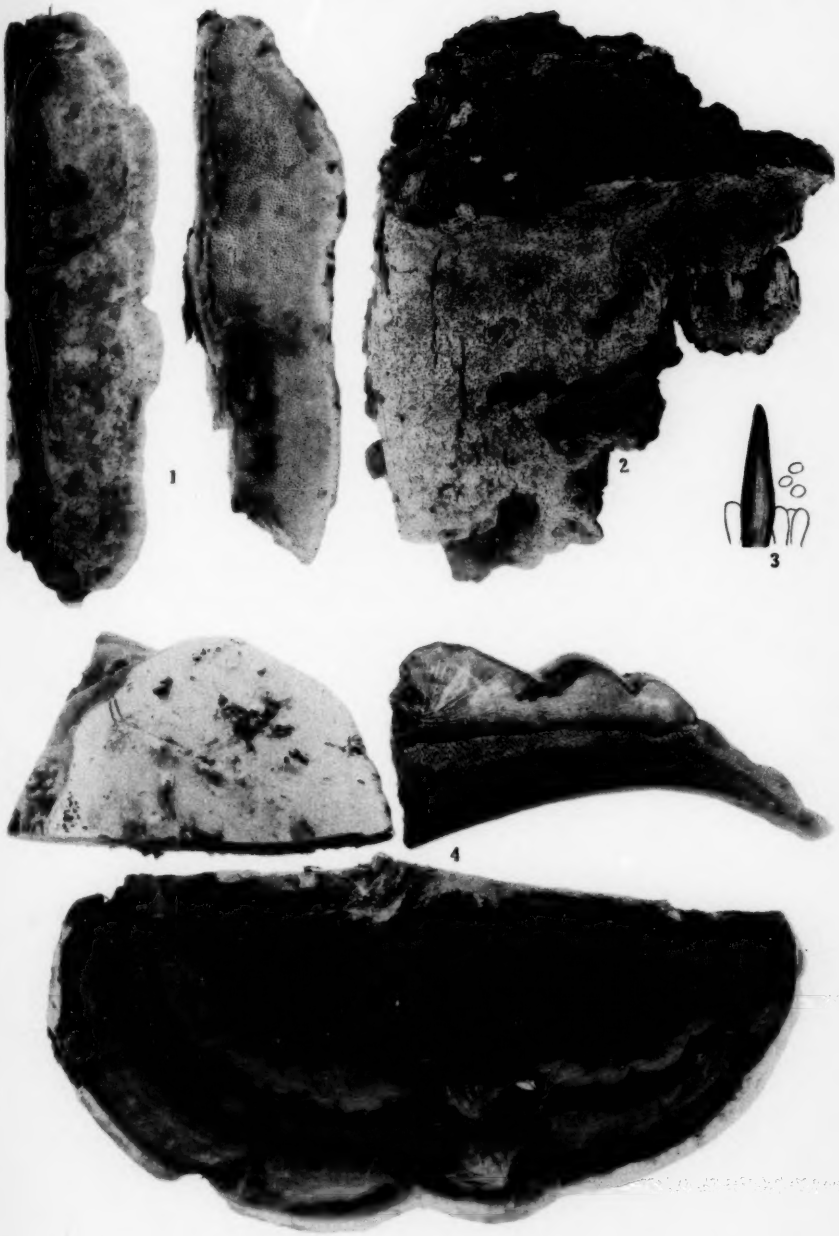
Explanation of Plate

PLATE 32

Fig. 1. Upper and lower surfaces of *Trametes subrosea* Weir. × 1.

Figs. 2–3. *Fomes Pini* (Thore) Lloyd. Fig. 2 shows front view. × ½. Fig. 3 shows a seta and spores. × 450.

Fig. 4. *Ganoderma applanatum* (Pers.) Pat. × 1. Upper and lower surfaces and vertical section are shown.



SHOPE — POLYPORACEAE OF COLORADO

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Explanation of Plate

PLATE 33

Figs. 1–3. *Fomes pinicola* (Sw.) Cooke. × 1. Fig. 1 shows pore surface of resupinate plant; fig. 2 shows vertical section; and fig. 3, habit view of a sporophore on aspen.

1

2

3

SHOPE — POLYPORACEAE OF COLORADO

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Explanation of Plate

PLATE 34

Figs. 1–2. *Fomes pinicola* (Sw.) Cooke. Fig. 1 shows a cystidium, spores, and a basidium. × 450. Fig. 2, the resinous coating on the upper surface of a sporophore from a coniferous host.

Fig. 3. *Fomes Demidoffii* (Lév.) Sacc. & Syd. × 1. The surface and pore layer are shown.

Figs. 4–6. *Fomes fulvus* (Scop.) Gill. × 1.

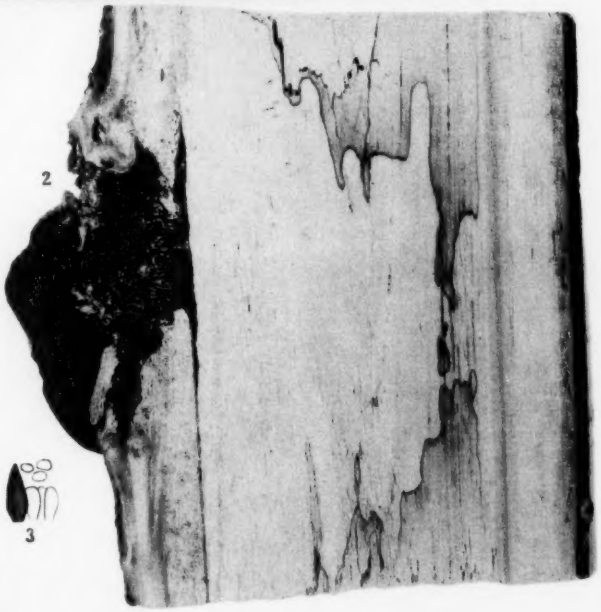
SHOPE — POLYPORACEAE OF COLORADO

Explanation of Plate

PLATE 35

Figs. 1–3. *Fomes igniarius* (L.) Gill. Fig. 1 shows this fungus growing on aspen. Fig. 2 shows a longitudinal section of rotted aspen wood with a sporophore attached. × 1. Fig. 3 shows a seta and spores. × 450.

1



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SHOPE — POLYPORACEAE OF COLORADO

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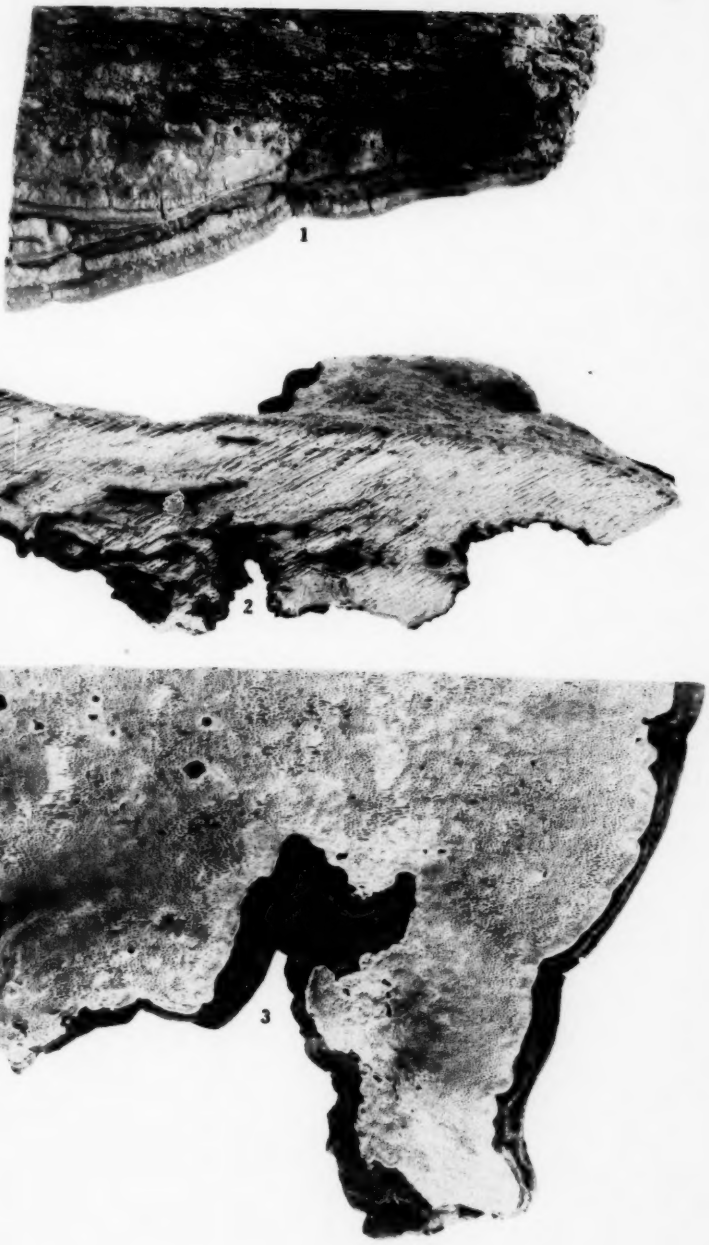
Explanation of Plate

PLATE 36

Figs. 1–3. Various views of *Fomes annosus* (Fr.) Cooke. × 1.



SHOPE — POLYPORACEAE OF COLORADO

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Explanation of Plate

PLATE 37

Fig. 1. *Lenzites saepiaria* (Wulf.) Fr. × 1. Three sporophores showing upper and lower surfaces, and places of attachment to the substrata.

Fig. 2. *Lenzites abietinella* (Murr.) Sacc. & Trott. = *L. saepiaria* (Wulf.) Fr. × 1. Upper and lower surfaces of type.

Fig. 3. *Fomes fraxinophilus* forma *Ellisianus* (And.) Baxter. × 1. Habit and pore layer.

SHOPE — POLYPORACEAE OF COLORADO

Explanation of Plate

PLATE 38

Fig. 1. *Lenzites trabea* (Pers.) Fr. × 1. Two upper surface views, one lamellae surface view, and one section view.

Figs. 2–3. *Fomes nigrolimitatus* (Rom.) Egel. × 1. Fig. 2 shows a seta and spores. × 450. Fig. 3 (upper) is a habit view showing the upper surface and the pore layer, also (lower) a vertical section.

Fig. 4. *Poria monticola* Murr. × 1.

Fig. 5. *Favolus alveolaris* (DC.) Quél. × 1. Three sporophores showing upper and lower surfaces.

SHOPE — POLYPORACEAE OF COLORADO

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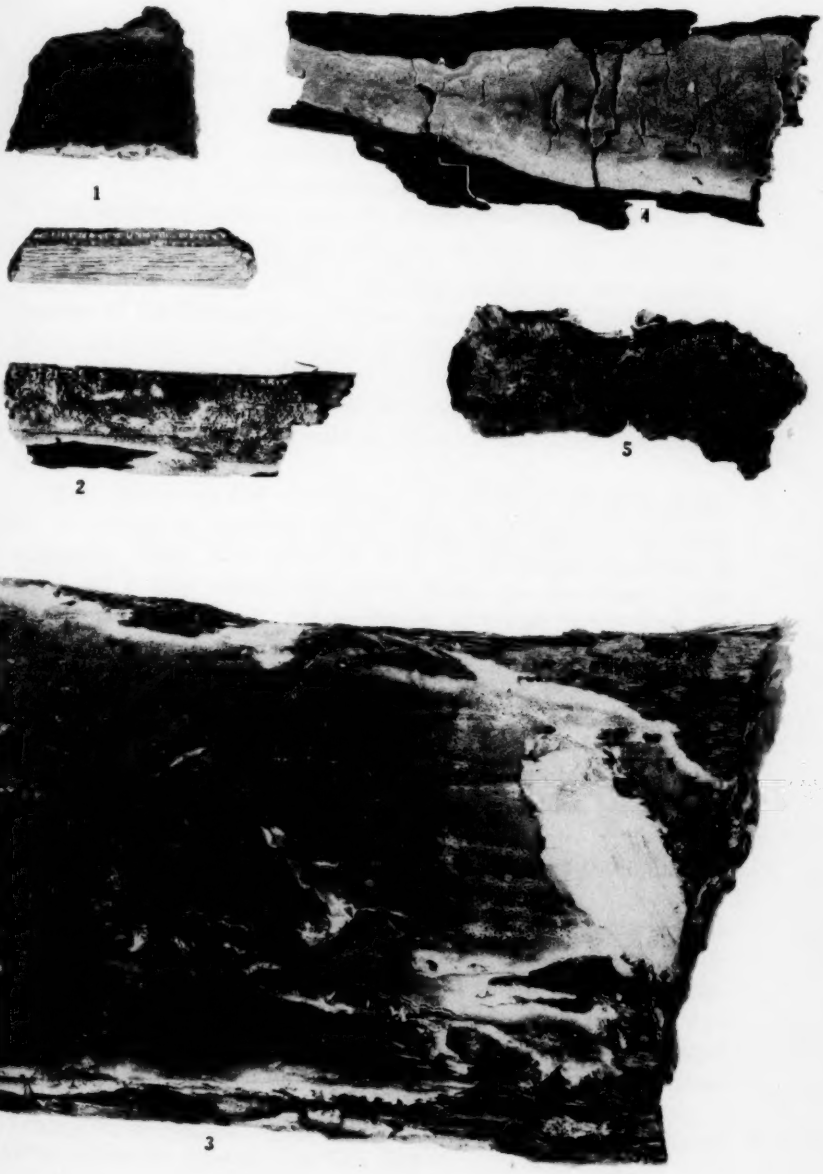
Explanation of Plate

PLATE 39

Fig. 1. *Poria spissa* (Schw.) Cooke. × 1. Pore view and section view.
Fig. 2. *Poria vaporaria* (Fr.) Cooke. × 1.
Fig. 3. *Poria subacida* (Pk.) Sacc. × 1.
Fig. 4. *Poria medulla-panis* (Jacq.) Pers. × 1.
Fig. 5. *Poria ferruginosa* (Schrad.) Pers. × 1.



SHOPE — POLYPORACEAE OF COLORADO

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ALPOVA, A NEW GENUS OF RHIZOPOGONACEAE, WITH FURTHER NOTES ON LEUCOGASTER AND ARCANGELIELLA

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In the summer of 1930, Dr. Alfred H. Povah, of the Isle Royale Lake Superior Survey, made several collections of a very puzzling member of the Hymenogasteraceae (*sensu latiore*). This fungus, which has been referred to a new genus, is very curious in uniting the peridial characters of *Hysterangium* with the gleba of *Leucogaster*, the scattered basidia of *Melanogaster*, and the spores of *Rhizopogon*. This genus should be placed in the Rhizopogonaceae of the author.[1]

Before discussing the morphology of *Alpova* in detail it might be of interest to turn our attention to the main evolutionary tendencies which have been at work in the Gasteromycetes, a seemingly highly specialized group which has developed quite independently of the Hymenomycetes, although it must be admitted that some members bear a striking resemblance to the Agaricaceae. The writer prefers to regard this as a convergence phenomenon connected with spore dispersal rather than of phylogenetic significance. If one considers the gasteromycetous condition of certain Boletaceae, one is tempted to consider the Gasteromycetes the more primitive group and that perhaps the Agaricales have developed from them.

As a working hypothesis, it seems probable that the following statements are true:

1. The primitive Gasteromycetes consisted of spherical or somewhat irregular fructifications with no differentiated sterile tissues and no stipe, the rhizomorphs on which the fruit-bodies were borne ending at the peridium. Gradually a cushion was formed at the point of attachment from which the larger tramal plates originated. This increased in size, penetrating farther into

Issued October 28, 1931.

[1] Dodge, C. W. Gasteromycetes in Gäumann & Dodge, Comparative morphology of fungi, pp. 468–470. New York, 1928.

the fructification until it fused with the peridium at its tip, forming a percurrent columella. Along with this development, the end of the rhizomorph developed a stipe to raise the fertile portion of the fructification above the substrate for better dispersal of spores.

2. The primitive peridium consisted of a single layer of hyphal tissue rather loosely woven. The additional layers have been developed in connection with more highly specialized fructifications in response to a more rigorous environment or to secure more efficient dispersal of spores.

3. The primitive gleba consisted of a loose, indefinite tramal tissue in which conidia, as well as the basidia, were borne. As the conidia lost their main function and degenerated *in situ*, they formed a gel which nourished the developing basidium and spores. In time they disappeared and left cavities in the gleba at approximately the same time that the basidia became organized in hymenia.

4. The primitive basidium was an eight-spored stichobasidium which gradually shortened its axis and became a chiastobasidium, reducing its spore number in many groups to four and in a few species to one.

5. The primitive spore was smooth, generally ellipsoidal and hyaline, and symmetrically placed at the tip of the sterigma. Spore discharge was at first effected by the degeneration of the basidium or the rupture of the sterigma, perhaps by increasing pressure in the basidium. In many of the more primitive Gasteromycetes, portions of the broken sterigmata may still be seen attached to the spore. The hymenomycetous type has progressed still farther with a highly developed mechanism for the discharge of an asymmetrically placed spore, so accurately described by Buller.[3] This hymenomycetous type is so fixed that it persists even in the gasteromycetous condition of *Boletinus decipiens* (Berk. & Curtis) Peck, where nearly all the other hymenomycetous characters have completely disappeared.

While the foregoing statements seem to be true, one sometimes finds an obviously highly developed form which has retained some primitive character, e. g., the basidium and spores of the Phal-

[3] Buller, A. H. R. Researches in fungi 3: 1–496. 1924.

laceae remain comparatively primitive whereas the tissues of the fructification have been highly specialized, even to the extent of securing insect dispersal of the spores.

When we turn our attention to *Alpova* in the light of the foregoing discussion, we find a very primitive member of the Rhizopogonaceae. The peridium is pseudoparenchymatous, of large, thin-walled cells, a character which our working hypothesis considers rather advanced, especially since it is comparatively rare elsewhere in the family. The trama, too, is composed of large, thin-walled, parallel hyphae, giving it a pseudoparenchymatous appearance. However, we have no highly differentiated sterile tissues.

The basidia are irregularly distributed through the fertile tissue between the layers of trama, apparently rising from large thin-walled hyphae from the trama which penetrate the gel formed by the decaying conidia (?). In *Leucogaster* we have a similar gel, but the basidia, although long-pedicellate, are always developed directly from the trama and form a loose hymenium. On the other hand, in the highly developed Podaxaceae, in both *Phellorinia* and *Podaxis* we have the basidia borne in compact clusters from small funiculi of large thin-walled hyphae (see pl. 40, fig. 6, for appearance of *Podaxis Farlowii*[3]).

The curious structures which form the gel into which the basidia grow are still unexplained. E. Fischer[4] considered them large sterile cells formed in the ground tissue as a kind of pseudoparenchyma in an early stage of *Leucogaster floccosus* Hesse, whereas the writer,[5] in view of the curious way in which they are borne, considered them to be vestigial conidia which may have lost their original function. Plate 40, fig. 4, shows a somewhat similar organ in an otherwise degenerated "cavity" of *Alpova*. Whether the much larger hyaline spheres also found in the fertile tissues of *Alpova* are borne in this manner is uncertain, since I have not been able to find their points of attachment.

[3] I am deeply indebted to Miss Elizabeth Morse of the University of California for excellent material of both *P. Farlowii* Massee, from which these figures were made, and of *P. anomalus* Lloyd, which shows the same condition.

[4] Fischer, E. Mykologische Beiträge, 25. Jugendstadien des Fruchtkörpers von Leucogaster. Naturf. Ges. Bern, Mitt. 1921: 301–307 [20–26]. 1922.

[5] Zeller, S. M. & C. W. Dodge. Leucogaster and Leucophlebs in North America. Ann. Mo. Bot. Gard. 11: 390–391. 1924.

The basidium of *Alpova* is especially interesting in that it is always eight-spored, which would point to a very primitive condition if we accept the hypothesis that the basidium and the ascus have been derived from a common ancestor after the number of ascospores in the ascus had been fixed at eight.[6] Eight spores per basidium is a very rare phenomenon in the Basidiomycetes, and I know of very few species where the number seems so fixed as in *Alpova*. In the Gasteromycetes, however, there are many species with basidia bearing more than four spores, as well as several species where occasionally or regularly only one very large spore is borne. In species where the number of spores has been fixed at four, many cases have been reported where the spore nucleus divides promptly, producing a binucleate spore. Hence it appears that meiosis immediately followed by a vegetative division giving eight nuclei is still fixed in the Gasteromycetes, although it is very rare in the Hymenomycetes.

The basidium of *Alpova* is long and slender, apparently of the stichobasidial type, although I have not had the opportunity to observe nuclear divisions in it. This type is apparently very rare in the Gasteromycetes, occurring only in a few American species of *Leucogaster*, whereas the other species of that genus appear to be of the chiastobasidial type. The occurrence of basidia on long, slender funiculi which traverse the fertile region is suggestive of conditions found in the Podaxaceae. In the latter, however, the basidium has already become four-spored with a thick-walled, colored spore, has shortened its long axis as a chiastobasidium (see pl. 40, fig. 7, *Podaxis Farlowii*), and assembled in dense tufts about nodes of the funiculi, whereas in *Alpova* the basidia are borne singly along the funiculi.

The spores of *Alpova* are ellipsoidal with a slightly thickened, smooth wall, hyaline under the microscope but colored brownish in mass, very much like *Rhizopogon* but much smaller in our species. This tiny ellipsoidal to bacilliform spore has been retained by several genera of lower Gasteromycetes and by the highly specialized Nidulariaceae, Phallaceae, and Clathraceae.

[6] Gäumann, E. A. Vergleichende Morphologie der Pilze. pp. 399–401. Jena, 1926.

ALPOVA gen. nov.

Fructificationes sphaericae, sine columella, sine stipite; gleba gelatinosa, locelli impleti, basidia in funiculis per locellos vagantibus, octospora; sporae ellipsoideae.

Alpova cinnamomeus Dodge, sp. nov. Pl. 40, figs. 1–5.

Fructificationes sphaericae, 5–20 mm. diametro metientes, cinnamomeae; peridium 300 μ crassitudine, cellulis magnis pseudo parenchymate; gleba cinnamomea, gelatinosa; locelli cellulis magnis qui in gelatina dilabunt, impleti; septa tenuia, 25–50 μ crassitudine pseudoparenchymate vel hyphis magnis parallelis qui pseudoparenchymatem simulant; basidia in funiculis hypharum magnarum per locellos vagantibus, longissima, 20 x 22 x 4–5 μ, octospora, sterigmatibus curtis; sporae hyalinae sub lente, cinnamomeae acervatae, ellipsoideae, 3–4 x 1.5–2.5 μ.

Type: Tobin Harbor trail, Isle Royale, Michigan, *C. A. Brown Fp. 73*, in Herb. Univ. Michigan.

Fructifications spherical, 5–20 mm. in diameter, pinkish buff to cinnamon buff, turning hazel to auburn (Ridgway); peridium thick, 300 μ, composed of large-celled pseudoparenchyma; gleba clay-color, turning Hessian brown, gelatinous, the spaces between the septa at first filled with large spherical cells (conidia?) which finally disintegrate; septa of large, thin-walled, hyaline, parallel hyphae which simulate pseudoparenchyma; basidia on slender funiculi as in the Podaxaceae, scattered irregularly in the gel, very long and slender, 20–22 x 4–5 μ, eight-spored with sterigmata about 1 μ long; spores hyaline under the microscope, pale brown in mass, ellipsoidal, 3–4 x 1.5–2.5 μ.

Half buried in soil, often under *Alnus*, Isle Royale, Lake Superior, July to September.

In view of the frequent affinities which plants of this region show with those of the Pacific slope, it is interesting to note that the species of *Leucogaster* to which this species appears most closely related are all Californian.

Specimens examined:

Michigan: Isle Royale, Tobin Harbor, *C. A. Brown Fp. 28, 73* type; Rock Harbor Trail, *A. H. Povah & G. L. Lowe Fp. 92, C. A. Brown Fp. 298;* Siskowet Outlet at Siskowet Bay, *A. H. Povah Fp. 635* (in Herb. Univ. Michigan).

During a recent visit to the herbaria of Europe the writer was able to study the types of most of the species of the Hymenogasteraceae. The following notes on synonymy of *Leucogaster* may

be of interest in this connection, since the genus seems so closely allied to *Alpova*.

Leucogaster nudus (Hazslinszky) Hollós, Mus. Nat. Hungarici Ann. **6**: 319. 1908; Magyarorszag Földalatti Gombai, 98, 208. 1911 (excl. syn.).

Hydnangium nudum Hazslinszky, K. K. Zool.-bot. Ges. Wien, Verhandl. **25**: 64–65. 1875; Magyar Tudomanyos Akad. Termeszettud. Közl. **13**: (9). 1875 [often cited as Magyarhon hasgombai, 9. 1876]; Hedwigia **16**: 44. 1877; Saccardo, Syll. Fung. **11**: 172. 1895.

Hydnangium virescens Quélet, Soc. d'Émul. Montbéliard Mem. 1875 [Champ. Jura et des Vosges **3**: 110. 1875]; Enchiridion, 248. 1886; DeToni in Sacc. Syll. Fung. **7**: 177. 1888.

Leucogaster luteomaculatus Zeller & Dodge, Ann. Mo. Bot. Gard. **11**: 394–395. 1924.

Type: cotype in Berlin. Authentic material of *Hydnangium virescens* collected at Waiter in the Vosges by Solms-Laubach and determined by Quélet in Upsala Bot. Mus. Inquiry in France failed to locate Quélet's herbarium if he left one. However, there is much material and many paintings in the Elias Fries Herbarium in Upsala. Apparently the situation is much the same here as in the case of Elias Fries' Swedish species, which are much more fully represented in the M. J. Berkeley Herbarium at Kew than they are in his own herbarium at Upsala. Type of *Leucogaster luteomaculatus* in the Farlow Herbarium at Harvard University.

L. citrinus (Harkness) Zeller & Dodge.

This species has also been seen from Mt. Lofty, South Australia, *J. B. Cleland 4*, not previously known outside California.

A study of all the types involved shows that the following species of *Octaviania* and *Hydnangium* should be transferred to *Arcangeliella*. The group of species centering about *Arcangeliella Stephensii* is separable with difficulty, and it is quite possible that they should be considered only varieties.

Arcangeliella rosea (Harkness) Zeller & Dodge, n. comb.

Octaviania rosea Harkness, Cal. Acad. Sci. Bull. **1**: 29. 1884.

Type: in Dudley Herb. at Leland Stanford Jr. University.

A. Stephensii (Berk. & Br.) Zeller & Dodge, n. comb.

Hydnangium Stephensii Berk. & Br. Ann. & Mag. Nat. Hist. I. **13**: 352. 1844.—*Octaviania Stephensii* Tulasne, Fung. Hypog. 78. 1851.—*Octavianina Stephensii* O. Kuntze, Rev. Gen. Pl. **3**^{2}: 501. 1898.

Type: in Kew, British Museum, and in Museum d'Histoire Naturelle de Paris.

A. Ravenelii (Berk. & Curtis) Dodge, n. comb.

Octaviania Stephensii v. *Ravenelii* Berk & Curtis in Tulasne, Fung. Hypog. xvii. 1851.—*Hydnangium Stephensii* v. *Ravenelii* Berk. Grev. **2**: 33. 1873.—*Hydnangium Ravenelii* Berk. & Curtis in Curtis, Bot. N. Car. 110. 1867.—*Octaviania Ravenelii* Lloyd, Myc. Notes 67: 1140. 1922.

Type: in Kew, in British Museum, and at Farlow Herbarium.

A. australiensis (Berk. & Br.) Dodge, n. comb.

Hydnangium australiense Berk. & Br. Linn. Soc. London, Trans. II. Bot. **2**: 66. 1883.—*Octaviania australiensis* Cooke, Handbook Austral. Fungi, 246. 1892.—*Hydnangium brisbanense* Berk. & Br. in Cooke, Handbook Austral. Fungi, 247. 1892.—*H. glabrum* Rodway, Papers & Proc. Roy. Soc. Tasmania **1920**: 157. 1921.

Type: both *H. australiense* and *H. brisbanense* were based on the same specimen, Brisbane, *F. M. Bailey 188*, at Kew and in British Museum. Cotype of *H. glabrum* in Dodge Herb.

Explanation of Plate

PLATE 40

Figs. 1–5. *Alpova cinnamomeus* Dodge.

Fig. 1. Section of peridium, × 285.

Fig. 2. Section of fructification showing peridium and gleba. The white areas of the gleba represent the hyaline septa. × 38.

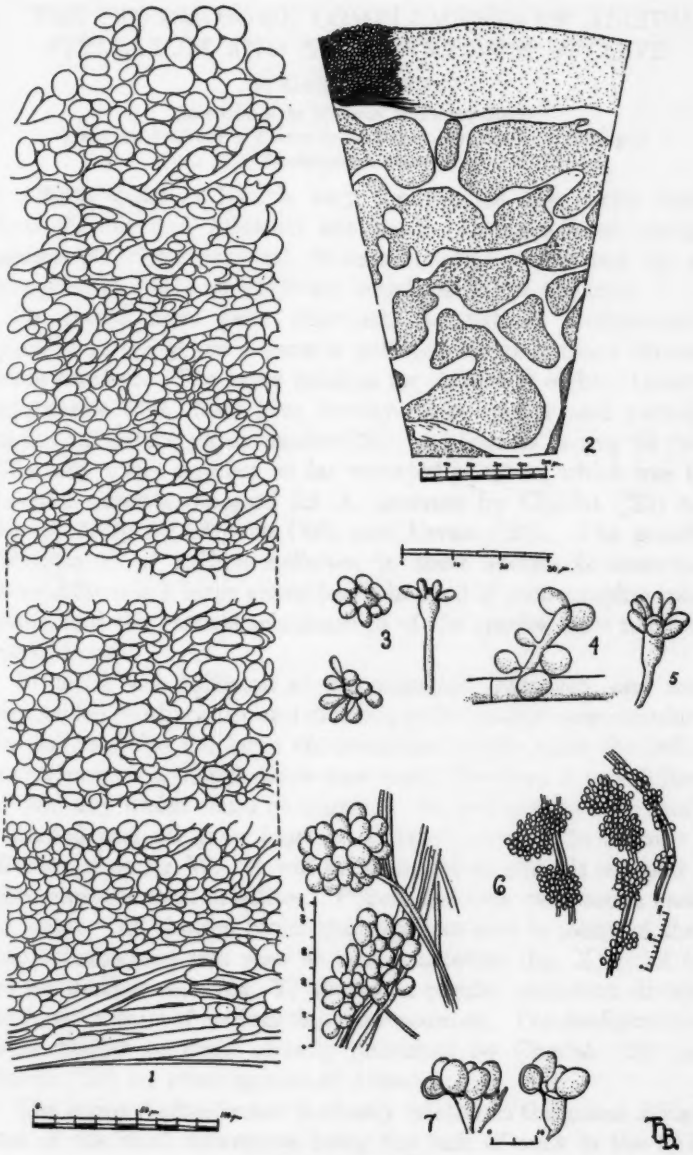
Figs. 3, 5. Basidia showing both top and side views. × 766.

Fig. 4. Hypha bearing the large thin-walled cells (conidia?) which gelify before the basidia develop. × 766.

Figs. 6, 7. *Podaxis Farlowii* Massee.

Fig. 6. Funiculi showing verticillate tufts of basidia. × 100, 433.

Fig. 7. Basidia and basidiospores. × 1400.



DODGE—ALPOVA

THE CHROMOSOME COMPLEMENTS OF ALLIUM STELLATUM AND NOTHOSCORDUM BIVALVE

EDGAR ANDERSON

Geneticist to the Missouri Botanical Garden
Associate Professor of Botany in the Henry Shaw School of Botany of Washington University

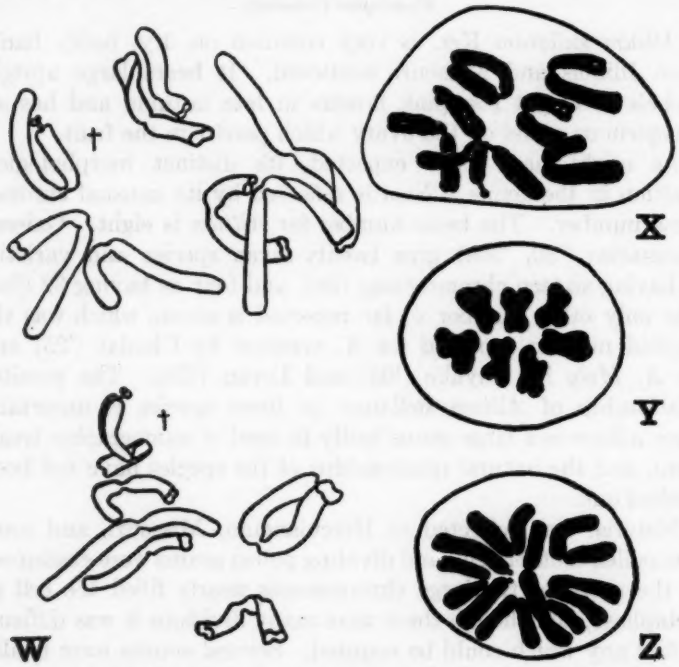
Allium stellatum Ker. is very common on dry, rocky banks from Illinois and Missouri westward. It bears large upright umbels of bright rose-pink flowers in late autumn and has six conspicuous crests on the ovary which persist in the fruit.

As might have been expected, its distinct morphological position in the genus *Allium* is reflected by its unusual chromosome number. The basic number for *Allium* is eight. Gaiser's summaries ('30, '30a) give twenty-seven species and varieties as having sixteen chromosomes (2n), and four as having 32 (2n). The only other number so far reported is seven, which was the haploid number reported for *A. ursinum* by Chodat ('25) and for *A. Moly* by Miyake ('05) and Levan ('29). The possible relationship of *Allium stellatum* to these species is uncertain, since *Allium* is a large genus badly in need of monographic treatment, and the natural relationships of the species have not been worked out.

Material was collected at Herculaneum, Missouri, and root-tips, pollen mother cells, and dividing pollen grains were examined. In the root-tips the large chromosomes nearly filled the cell at metaphase, and though there were many divisions it was difficult to find any which could be counted. Several counts were finally obtained and all gave fourteen chromosomes. The clearest is illustrated in fig. W. It will be noticed that there is one pair of chromosomes with satellites. Pollen divisions were much easier to count. All showed seven chromosomes and in many of them one chromosome was seen to bear a satellite (fig. X). All the pollen mother cells (fig. Y) showed a regular reduction division with seven pairs of conjugating chromosomes. The configurations were similar to those already published by Chodat ('25) and Levan ('29) for other species of *Allium*.

The genus *Nothoscordum* is closely related to the genus *Allium*, one of the chief differences being the lack of odor in the bulbs

and leaves of the former. Smears of young pollen grains were made from two plants of *Nothoscordum bivalve* (L.) Britton, collected at Cliff Cave, Missouri. Pollen grains of each plant were found to have nine (n) chromosomes (fig. Z), seven with median or sub-median constrictions, and two with terminal constrictions.



W, Somatic chromosomes (2n = 14) from the root-tip of *Allium stellatum*. The figure has been separated for clearness and may be reassembled by superposing the † 's.

X, Dividing pollen grain of *A. stellatum*. × 1900.

Y, Pollen mother cell of *A. stellatum*, polar view. × 1900.

Z, Dividing pollen grain of *Nothoscordum bivalve*. × 1800.

All figures drawn with camera-lucida at bench level and reduced one-half for illustration.

These latter are conspicuously marked by large, deep-staining insertion points. The chromosomes, like those of *Allium*, are large and ribbon-like. The attachment constrictions in *Allium* are usually median or sub-median (or at most sub-terminal). It

seems quite possible that *Nothoscordum* may have been derived from an eight-chromosomed parental stock by the division of one of the large median-constricted chromosomes. This is further borne out by the fact that the combined length of the two chromosomes with terminal constrictions is only a very little greater than that of the longest chromosome with a median constriction.

Bibliography

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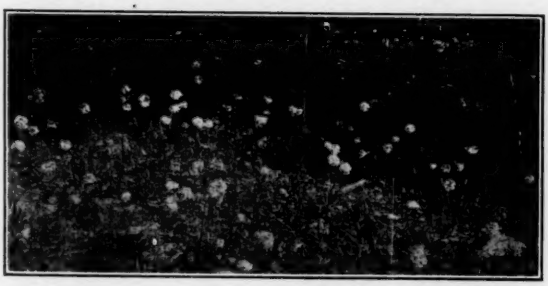
Explanation of Plate

PLATE 41

Fig. 1. *Allium stellatum* on limestone outcrop, Festus, Missouri.
Fig. 2. *Allium stellatum*, representative umbels.

1



2

ANDERSON—ALLIUM AND NOTHOSCORDUM

HYMENOMYCETOUS FUNGI OF SIBERIA AND EASTERN ASIA—MOSTLY OF WOOD-DESTROYING SPECIES

EDWARD ANGUS BURT

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The fungi enumerated in the following list were received from Professor K. E. Murashkinsky of the Siberian Agricultural Academy, Omsk, Siberia, in two lots. The first, consisting of 113 specimens, was received in February, 1928. Some of the specimens were already named, whereas others were for me to study and report results. After a report concerning this sending had been made the second and larger consignment of specimens arrived, study of which was completed recently.

The complete series of some 250 carefully selected specimens, with record for each of the botanical names of the substratum upon which growing and the widely separated localities across Siberia proper and Eastern Asia to Vladivostok, has been of great interest in extending westward the range of some species heretofore known only in the United States and in extending the eastern range of many European species. Descriptions of some of the rare and more or less imperfectly known species of Fries and of Karsten would seem in the light of these specimens to have been based on isolated gatherings from the extreme western limits of the range of each. An example of the latter is *Stereum ochroleucum* Fr., concerning which the mycologists of central and southern Europe are in error.

An early study comprising all groups of the fungi of Siberia collected by Martinoff, chiefly from the region of Minussinsk, was made by Baron de Thümen, assisted by specialists. The results were published in five parts as Thümen, 'Beiträge zur Pilz-flora Siberiens,' in Soc. Imp. Moscou Bul. Vols. 52, 53, 55 and 56, of the years 1877–1881. Saccardo published an additional list of Siberian fungi in Soc. Roy. Bot. Belg. Bul. Vol. 28, pp. 77–117. *pl. 4–6.* 1889, and included in his work a list of all the species given in the five papers by de Thümen. In the following

list, confined to Hymenomycetes and covering more equally all northern Asia rather than Minussinsk, I have checked with an asterisk * each species given before in the lists of de Thümen and Saccardo.

The collections in the Districts of Omsk, Tara, and Sajany, Siberia, were usually made by Professor Murashkinsky, those in the District Barnaoul, Siberia, by Konjev, those in District Amur, Eastern Asia, by Krawtzew, and those in District Vladivostok, Eastern Asia, by Ziling. All received are preserved in my herbarium.

AGARICACEAE

***Pleurotus applicatus** (Batsch) Berk.

On *Sorbus Aucuparia*, Altai, Asia, July 12, coll. *Murashkinsky*.

***Schizophyllum commune** Fr.

On *Picea excelsa*, District Tara, Siberia, August, coll. *Murashkinsky*, B 4.

Lenzites heteromorpha Fr.

On *Abies sibirica*, District Sajany, Siberia, August, coll. *Murashkinsky*.

Lenzites laricina Karst. Soc. pro Fauna et Fl. Fennica Acta 27[4]: 4. 1905.

On *Larix sibirica*, District Sajany, Siberia, July 10, coll. *Murashkinsky*, B 9; on *Larix sibirica*, Altai, Asia, August, comm. by K. E. Murashkinsky, B 41; on *Larix dahurica*, District Amur, Eastern Asia, October, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 093.

Lenzites septentrionalis Karst.

On *Betula verrucosa*, District Tara, Siberia, June, coll. *Murashkinsky*, B 13.

Lenzites tenuis Lév.

On rotting trunks, District Vladivostok, Eastern Asia, June, coll. *Ziling*, comm. by K. E. Murashkinsky, B 0150. The specimen bearing this name was too badly eaten by insects for study.

POLYPORACEAE

Polystictus abietinus (Dicks.) Fr.

On *Abies sibirica*, District Sajany, Siberia, July, coll. *Murashkinsky*.

***Polystictus biformis** Klotzsch

On rotting wood of *Betula dahurica*, District Amur, Eastern Asia, August, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 089.

***Polystictus hirsutus** (Wulf.) Fr.

On *Prunus Padus*, District Tomsk, Siberia, August, coll. *Ziling*, comm. by K. E. Murashkinsky.

Polystictus pergamenus Fr.

On *Abies sibirica*, District Sajany, Siberia, August, coll. *Ziling*, comm. by K. E. Murashkinsky; on *Carpinus betulus*, Dagestan, Russia, May, coll. *Sheludjanova*, comm. by K. E. Murashkinsky.

Polystictus radiatus (Sow.) Fr.

On *Betula japonica*, District Amur, Eastern Asia, August, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 099.

***Polystictus vulpinus** Fr.

On *Populus tremula*, District Sajany, Siberia, July, coll. and det. by *Murashkinsky*.

***Polyporus adustus** Fr.

On *Polulus tremula*, District Sajany, Siberia, July, coll. *Murashkinsky*, B 23; on *Populus tremula*, District Tara, Siberia, October, coll. *Ziling;* on *Betula pubescens*, District Omsk, Siberia, August, coll. *Murashkinsky*, B 31; on *Carpinus cordata*, District Vladivostok, Eastern Asia, August, coll. *Ziling*, comm. by K. E. Murashkinsky, B 0151.

***Polyporus amorphus** Fr.

On *Pinus silvestris*, District Tara, Siberia, June, coll. *Murashkinsky*, B 2.

Polyporus benzoinus (Wahl.) Fr.

On *Picea excelsa*, District Tara, Siberia, September, coll. *Subatsh*, comm. by K. E. Murashkinsky, B 18.

***Polyporus brumalis** (Pers.) Fr.

On *Betula japonica*, District Amur, Eastern Asia, October, coll. *Krawtzew;* on *Betula dahurica*, Blagowietschensk, Eastern Asia,

October, coll. *Krawtzew*, both comm. by K. E. Murashkinsky, B 0102 and B 0104 respectively.

Polyporus delectans Pk.

On *Quercus mongolica*, District Amur, Eastern Asia, October, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 0126.

Polyporus dichrous Fr.

On *Betula pubescens*, District Sajany, Siberia, September, coll. *Konjev*, comm. by K. E. Murashkinsky, B 15; on *Populus tremula*, District Tara, Siberia, June, coll. *Murashkinsky*, B 50.

Polyporus dryadeus (Pers.) Fr.

On *Populus tremula*, District Amur, Eastern Asia, October, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 0100.

Polyporus fibrillosus Karst.

Polyporus aurantiacus Pk.

On *Picea excelsa* and on *Pinus silvestris*, District Sajany, Siberia, June, coll. *Murashkinsky*, B 6 and an unnumbered specimen.

Polyporus frondosus Fr.

On buried wood, District Amur, Eastern Asia, August, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 0201.

Polyporus gilvus Schw.

On *Quercus mongolica*, District Vladivostok, Eastern Asia, July, coll. *Ziling*, comm. by K. E. Murashkinsky, B 0132.

Polyporus hispidus (Bull.) Fr., resupinate.

On *Quercus mongolica*, District Amur, Eastern Asia, October, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 0124.

The fragment of a fructification received consists of resupinate tubes 15 mm. long, 3 to a mm., attached by a thin layer of substance to oblique surfaces of decorticated wood. No setae are present in the hymenium, spores are copious, colored, even, somewhat flattened on one side, 5–7 × 4–5 μ. The specimen is so similar to *P. hispidus* in tubes, color of substance, and in spores that it seems to be from a resupinate portion of *P. hispidus* on an oblique surface. Nevertheless it may be a true *Poria* of a species not known to me.

***Polyporus lacteus** Fr.

On *Populus tremula*, District Omsk, Siberia, October, coll. *Ziling;* on *Betula verrucosa*, District Tomsk, Siberia, August, coll. *Ziling;* on *Salix* sp., District Amur, Eastern Asia,—all comm. by K. E. Murashkinsky, B 14, an unnumbered specimen, and B 098.

Polyporus lentus Berk.

On *Betula pubescens*, District Omsk, Siberia, September, coll. *Ziling*, comm. by K. E. Murashkinsky, B 29.

Polyporus melanopus (Swartz) Fr.

On *Abies sibirica*, District Tara, Siberia, October, coll. *Baranov;* on *Abies sibirica*, District Sajany, coll. *Murashkinsky*, B 60.

Polyporus osseus Kalchb.

On *Betula verrucosa*, District Omsk, Siberia, August, coll. *Ziling*, comm. by K. E. Murashkinsky, B 19.

Polyporus pubescens (Schum.) Fr.

On *Quercus mongolica*, District Amur, Eastern Asia, August, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 0128.

Polyporus resinosus (Schrad.) Fr.

On *Abies sibirica*, Altai, Mongolia, July, coll. *Baranov*, comm. by K. E. Murashkinsky.

Usually found on wood of frondose species in collections by the writer.

Polyporus rutilans (Pers.) Fr.

On *Populus tremula*, District Tara, Siberia, July, coll. *Murashkinsky*, B 62.

Polyporus spumeus (Sow.) Fr.

On *Quercus mongolica*, District Amur, Eastern Asia, October, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 0130.

Polyporus squamosus (Huds.) Fr.

On *Populus tremula*, Altai, Mongolia, coll. *Shingosijev*, comm. by K. E. Murashkinsky.

Polyporus trichrous Berk. & Curtis?

On *Betula verrucosa*, Altai, Mongolia, August, coll. *Smirnov*, comm. by K. E. Murashkinsky, B 40.

Fructification is very thin, with soft, white substance sugges-

tive of *P. trichrous* and *P. leucospongia;* spores hyaline, even, 3–4 × 2–3 μ; no cystidia nor setae.

Fomes fulvus Fr.

On *Quercus mongolica*, District Amur, Eastern Asia, October, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 0127.

***Fomes igniarius** (L.) Fr.

On *Betula pubescens*, District Omsk, Siberia, June, coll. *Murashkinsky*, B 5; on *Betula verrucosa*, District Tara, Siberia, coll. *Murashkinsky;* on *Alnus fruticosa*, District Sajany, Siberia, coll. *Murashkinsky*.

***Fomes pinicola** Fr.

On *Picea excelsa*, District Tara, Siberia, July, coll. *Murashkinsky;* on *Pinus sibirica*, Tobolsk, Siberia, September, coll. *Dravert*, comm. by K. E. Murashkinsky; on *Abies sibirica*, Altai, Mongolia, July, coll. *Baranov*, comm. by K. E. Murashkinsky.

Fomes Palliseri Berk.

On *Picea excelsa*, District Tara, Siberia, August, coll. *Murashkinsky*, B 3.

Fomes roseus (Alb. & Schw.) Fr.

On *Abies sibirica*, District Sajany, Siberia, July, coll. *Murashkinsky*.

Trametes Abietis Karst.

On *Pinus silvestris*, District Tara, Siberia, coll. *Murashkinsky*, B 35.

Trametes hispida (Bagl.) Fr.

On *Populus nigra*, District Sajany, Siberia, June, coll. *Murashkinsky*, B 17.

Trametes inodora Fr. Icones Hym. *pl. 191, f. 1.*

On bark of decaying *Quercus mongolica*, District Amur, Eastern Asia, August 15 and 29, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 0121 and B 0125.

These specimens are referred to *Trametes inodora* rather than to *T. suaveolens*, because the tube mouths have not darkened and are rather regularly about 2 to a mm.

Trametes protracta Fr. Icones Hym. *pl. 191, f. 3.*

Trametes trabea Pers. sec. Bresadola, I. R. Accad. Agiati Atti III. 3: 90. 1897.

On *Pinus silvestris*, District Barnaoul, Siberia, July, coll. *Konjev*, comm. by K. E. Murashkinsky, B 020; on *Populus tremula* and on *Quercus mongolica*, October and September, District Amur, Eastern Asia, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 090 and B 0105 respectively.

In one specimen there were found a few spores, colored, even, 10–11 × 7 μ, but so few that they may be foreign; all the specimens have cystidia with colored, capitate, aculeate tips.

Trametes radiata Burt, n. sp.

Type: in Burt Herb.

Fructification light drab of Ridgway, dimidiate, sessile, triquetrous, glabrous, strongly radiately rugose, the margin thin, entire; flesh white, soft, corky, equalling the tubes in thickness, drying without noteworthy taste or odor; tubes white, up to 8 mm. long, about 2–2½ to a mm., angular, the mouths warm buff, entire; no spores present; no cystidia, setae, nor hyphal fascicles present in the hymenium.

Fructification 4 cm. long, 7 cm. wide, 1½ cm. thick.

On *Betula dahurica*, District Amur, Eastern Asia, Oct. 15, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 0122.

Trametes radiata belongs in the group with *T. suaveolens* but has a smaller, light drab fructification which is strongly radiately rugose, and smaller tubes the mouths of which are not smoky.

Trametes suaveolens (L.) Fr.

On *Salix* sp., District Tara, Siberia, June, coll. *Murashkinsky*, B 10.

***Trametes stereoides** (Fr.) var. **Kmetii** Bres.

On *Salix* sp., District Omsk, Siberia, September, coll. *Ziling*, comm. by K. E. Murashkinsky.

***Trametes gibbosa** (Pers.) Fr.

On *Populus tremula*, District Tara, coll. *Murashkinsky*, B 21.

Daedalea confragosa (Bolt.) Fr.

On *Populus tremula*, District Tara, Siberia, August, coll. *Mu-*

rashkinsky, B 8; on *Betula verrucosa*, District Sajany, Siberia, September, coll. *Konjev*, comm. by K. E. Murashkinsky, B 11.

Daedalea aurea (Batt.) Fr.

On *Betula pubescens*, District Tara, Siberia, September, coll. *Murashkinsky*.

***Daedalea quercina** (L.) Fr.

On rotting trunks, District Vladivostok, Eastern Asia, June, coll. *Ziling*, comm. by K. E. Murashkinsky, B 0132.

Remarkable by having diameter of tubes and thickness of dissepiments only about half that of American and European specimens.

***Daedalea unicolor** (Bull.) Fr.

On *Betula pubescens*, District Omsk, and on *Betula verrucosa*, District Sajany, Siberia, September and July, coll. *Murashkinsky*, B 22 and an unnumbered specimen.

Poria caesio-alba Karst.

On *Abies holophylla*, Primorje, District Vladivostok, Eastern Asia, June, coll. *Ziling*, comm. by K. E. Murashkinsky, B 032c.

Poria laevigata Fr.

On *Betula pubescens*, District Omsk, Siberia, September, coll. *Ziling*, comm. by K. E. Murashkinsky, B 27.

Poria mucida (Pers.) Fr.

On bark of *Picea excelsa*, Altai, Mongolia, July, coll. *Murashkinsky*, B 33.

Poria taxicola (Pers.) Bres.

On *Pinus silvestris*, District Tara, Siberia, June, coll. *Murashkinsky*.

This specimen has hyaline, even, allantoid spores 4–4½ μ, not abundant; no setae, cystidia, hyphal fascicles, nor gloeocystidia.

Poria xantha Fr.

On charcoal, District Tara, Siberia, coll. *Murashkinsky*.

Porothelium Friesii Mont.

On *Abies sibirica*, District Tara, Siberia, September, coll. *Murashkinsky*, B 08.

Separable; spores colorless, even, 4 × 2½ μ; no setae, cystidia, nor hyphal fascicles.

Merulius serpens Fr.

On bark of *Juniperus communis*, District Tara, Siberia, June, coll. *Murashkinsky*.

***Merulius tremellosus** Fr.

On *Betula pubescens*, District Omsk, Siberia, September, coll. *Murashkinsky*, B 7 and an unnumbered specimen.

HYDNACEAE

Hydnum auriscalpium L.

On *Pinus silvestris*, District Omsk, Siberia, September, coll. *Baranov*, comm. by K. E. Murashkinsky.

Hydnum Erinaceus Bull.

On *Quercus mongolica*, District Amur, Eastern Asia, November, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 082.

Hydnum Hollii (Schmidt) Fr.

On rotting frondose wood, District Omsk, Siberia, September, coll. *Ziling*, comm. and det. by K. E. Murashkinsky.

Hydnum Murashkinskyi Burt, n. sp.

Type: in Burt Herb.

Fructifications coriaceous-corky, drying rigid, dimidiate, sessile, slightly decurrent at the base, imbricate, laterally confluent, concentrically sulcate, fibrillose, drying cinnamon-buff of Ridgway, the margin thin, light-colored, entire, substance up to 4 mm. thick, colored like the pileus; teeth snuff-brown, 2–4 mm. long, cylindric, acute, 240 μ in diameter, about 3–4 to a mm.; no special conducting organs in substance, trama, or hymenium; no cystidia, occasional hyphal fascicles protruding from the hymenium; spores white, even, 2½ × 1½ μ.

Fructifications 1½–2 cm. long, 2–6 cm. broad by confluence, 6–8 mm. thick.

On bark of decaying *Betula verrucosa*, District Tara, Siberia, September 1, 1928, coll. *Murashkinsky*, B 04, type.

This species is related to *H. adustum* but the pileus is concentrically sulcate and glabrous, attached by the full width of the

dimidiate pileus rather than by a distinct stem or more or less stem-like base, and the hyphal fascicles of the hymenium are more conspicuous than those of *H. adustum*.

Hydnum ochraceum Pers.

On *Betula pubescens*, District Omsk, Siberia, July and September, coll. *Murashkinsky*, B 28 and an unnumbered specimen; on *Betula verrucosa*, District Tara, September, coll. *Murashkinsky*, B 010.

Hydnum reflexum Burt, n. sp.

Type: in Burt Herb.

Fructification 2½ cm. long, 4 cm. broad, effuso-reflexed, mostly resupinate, with the margin reflexed 5 mm., coriaceous, tomentose, drying cinnamon-buff of Ridgway, thin, entire; substance colored like reflexed surface, up to 1 mm. thick; teeth drying cinnamon, about 2 mm. long, cylindric, acute, about 3 to a mm.; no special conducting organs in the substance or the hymenium; no cystidia; small hyphal fascicles protrude from the hymenium up to 20 to 25 μ above its surface; a few floating spores are colorless, even, 4 × 2½ μ but may be foreign.

On bark of *Betula*, District Bijsk, Siberia, October 3, 1928, coll. *Dravert*, comm. by K. E. Murashkinsky, B 0129, type.

Hydnum reflexum may be distinguished from the effuso-reflexed species heretofore known by the tomentose, cinnamon-buff surface of the free margin, by the somewhat darker teeth, by the occurrence of hyphal fascicles like those of *Polyporus hirsutus* protruding here and there in the hymenium, and by the absence of cystidia.

Hydnum velutinum Fr.

On the ground, District Tara, Siberia, July, coll. *Murashkinsky*.

***Irpex fusco-violaceus** Fr.

On *Abies excelsa*, District Sajany, Siberia, September, coll. *Autonov*, comm. by K. E. Murashkinsky.

***Irpex lacteus** Fr.

On *Salix* sp., District Omsk, Siberia, September, coll. *Murashkinsky;* on *Betula verrucosa* and *Betula pubescens*, District Sajany, Siberia, July and August, coll. *Ziling*, comm. by K. E. Murashkinsky, B 16 and B 30 respectively.

Irpex pachyodon (Pers.) Bres.

On *Alnus hirsuta*, District Amur, Eastern Asia, October, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 0120.

Phlebia radiata Fr.

On *Betula verrucosa*, District Omsk, Siberia, August, coll. *Murashkinsky*, B 1.

Phlebia strigoso-zonata (Schw.) Lloyd. See Burt, Mo. Bot. Gard. Ann. **8**: 393–395. 1921.

On *Populus tremula*, District Amur, Eastern Asia, October, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 081.

Odontia bicolor (Alb. & Schw.) Bres.

On *Betula* sp., District Lushsk, Province Petrograd, August, coll. *Boudartzev*, comm. by K. E. Murashkinsky.

Kneiffia setigera Fr.

On *Alnus fruticosus*, District Sajany, July, coll. *Murashkinsky*, det. Kurpowa.

THELEPHORACEAE

***Craterellus cornucopioides** Fr.

On ground, District Irkutsk, Siberia, August, comm. by K. E. *Murashkinsky*.

Thelephora palmata (Scop.) Fr.

On ground, District Tara, Siberia, August 21, coll. *Murashkinsky*, B 06.

Thelephora tenuis Burt, n. sp.

Type: in Burt Herb.

Fructifications drying Verona brown of Ridgway, cespitose, dimidiate, sessile, imbricate, confluent, soft, flexible, fibrous, with the fibrils somewhat matted together to form a roughened but not squamulose upper surface, very thin, only 700 μ thick in section, the margin thin, concolorous; hymenium inferior, Verona brown, fibrous, even, not at all papillose; spores dark umbrinous under the microscope, subangularly globose or ellipsoidal, rough, 7–8 × 6–7 μ.

Clusters 3–4 cm. in diameter; individual pileus 1–1⅓ cm. long, 1½–2 cm. broad, 600–700 μ thick.

On sandy ground, District Amur, Eastern Asia, August 20, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 084, type.

Thelephora tenuis is related to *T. intybacea* but is thinner, with fibrils of the upper surface not matted into squamules, the margin concolorous, and the hymenium not papillose.

Thelephora terrestris Ehrh.

On ground, District Tara, Siberia, June, coll. *Murashkinsky;* on ground and on roots of *Quercus mongolica*, District Amur, Eastern Asia, July 27, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 096.

Hypochnus spongiosus (Schw.) Burt

On decaying wood of *Pinus silvestris*, District Tara, Siberia, September, coll. *Murashkinsky*, B 02.

Hypochnus umbrinus Fr. ?

On fallen limb of *Picea obovata*, District Tara, Siberia, August, coll. *Murashkinsky*, B 011.

Young, sterile, mycelial stage of this species in my opinion.

Stereum Chailletii Pers.

On *Pinus silvestris*, District Omsk, Siberia, September, coll. *Murashkinsky*.

Stereum fasciatum Schw.

On *Pinus* sp., District Tara, Siberia, September, coll. *Baranov;* on *Betula verrucosa* and on *Pinus silvestris*, District Barnaoul, Siberia, May, coll. *Konjev*, comm. by K. E. Murashkinsky, B 026 and B 027; on *Quercus mongolica*, District Amur, Eastern Asia, October, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 085 and B 0200; on deciduous wood, Primorje, District Vladivostok, Eastern Asia, June, coll. *Ziling*, comm. by K. E. Murashkinsky, B 037.

Stereum fasciatum is widely distributed; very common in North America, it is present in Herb. E. Fries at Upsala from Norway as the type of *Stereum arcticum*. I have two collections of *S. fasciatum* from the Tirol comm. by Litschauer under the name *S. lobatum*—a species of more tropical range. *S. fasciatum* is perhaps common in the southern hemisphere also, for I have received five collections from Professor P. A. van der Bijl made by him on

Eucalyptus and other wood at Victoria Falls, Rhodesia, Transvaal, and Cape, South Africa.

Stereum fuscum (Schrad.) Quelet (= *S. bicolor* Fr.)

On *Betula pubescens*, District Omsk, Siberia, September, coll. *Murashkinsky*, also *Ziling*, comm. by K. E. Murashkinsky, B 15; resupinate on *Quercus mongolica*, District Amur, Eastern Asia, October, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 080.

Stereum gausapatum Fr.

On *Quercus pedunculata*, Sestrorjetzk, Siberia, August, coll. *A. Boudartzev*, comm. by K. E. Murashkinsky.

Stereum hirsutum (Willd.) Fr.

On *Alnus fruticosus*, District Sajany, Siberia, July, coll. *Murashkinsky;* on *Betula verrucosa*, District Tara, Siberia, September, coll. *Murashkinsky*, B 096.

Stereum ochroleucum Fr.

On decaying limb of *Quercus mongolica*, District Amur, Eastern Asia, August 25, 1928, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 086.

This gathering is a very important find, for European mycologists since the time of Fries have erroneously referred to *S. ochroleucum* specimens of very different structure from that of the authentic specimen in Kew Herbarium, the true structure of which was given in detail in my work on *Stereum* in Mo. Bot. Gard. Ann. 7: 235. 1920.

In the present gathering from Eastern Asia the fructifications are smaller than the authentic specimen, for some of those wholly resupinate are only 2 mm. in diameter, whereas the larger narrowly reflexed specimens are about 5 mm. in diameter. The color and internal structure agree with those of the authentic specimen. The hyphae are interwoven throughout, 2½ μ in diameter, nodose-septate, with no intermediate layer of longitudinally arranged hyphae. No hardened crust nor golden zone marks the upper limit of the intermediate layer. No gloeocystidia nor colored conducting organs are present. The spores are copious for a *Stereum*, hyaline, even, 4½–6 × 3½–4 μ.

Since known stations for *S. ochroleucum* are Sweden and Amur, future collections may be expected from Russia and Siberia.

Stereum Pini Fr.

On *Pinus silvestris*, District Barnaoul, Siberia, July, coll. *Konjev*, comm. by K. E. Murashkinsky, B 018.

***Stereum rhytidocyclum** Sacc. & F. Sacc. Soc. Roy. Bot. Belg. Bul. 28: 79. *pl. 4. f. 1.* 1889; Syll. Fung. 9: 226. 1891.

On wood which has microscopic structure of a frondose species but is erroneously stated on the label as *Abies sibirica*, District Tara, Siberia, August, coll. *Murashkinsky*, B 05. The type was collected on trunks of *Sorbus Aucuparia* in subalpine woods, Golubaja, Siberia.

The present Tara gathering is effuso-reflexed with the resupinate part about 3–5 × 1½–2 cm. and one margin reflexed about 2–3 mm., concentrically sulcate on the upper surface, warm buff of Ridgway and rough but not hairy, the margin entire; hymenium even, cinnamon-drab of Ridgway; in section about 700 μ thick, composed of loosely arranged, colorless, even-walled, rather rigid, somewhat interwoven hyphae not nodose septate, 2–3 μ in diameter, which extend obliquely from substratum to hymenium and have their tips somewhat colored and agglutinate in the hymenium; no colored conducting organs, setae, cystidia, nor hyphal fascicles; the only spore found is colorless, even, about 14 × 8 μ but may be foreign.

This species may be distinguished from *Stereum sanguinolentum* by absence of colored conducting organs and occurrence on frondose wood, and from *S. fasciatum* and *S. hirsutum* by more paper-like consistency and upper surface of reflexed margin not being tomentose nor hirsute.

Stereum rugosiusculum Berk. & Curtis. See Burt, Mo. Bot. Gard. Ann. 7: 127. *text f. 14.* 1920.

On *Populus tremula*, District Tara, Siberia, August, coll. *Murashkinsky*, B 07 and B 013.

Stereum rugosum Pers.

On *Alnus fruticosa*, District Sajany, Siberia, July, coll. *Murashkinsky*.

Stereum sanguinolentum Alb. & Schw.

On *Pinus silvestris*, District Tara, Siberia, August and September, coll. *Ziling*, 2 unnumbered specimens comm. by Murashkin-

sky; on *Picea excelsa* and *Abies sibirica*, District Tara, Siberia, September, coll. *Murashkinsky*, B 09a and B 014.

Stereum spadiceum (Pers.) Bres.

On *Ailanthus glandulosa*, Russia, July, ex Herb. Jaczewski, comm. by K. E. Murashkinsky.

Stereum sulcatum Burt

On *Larix sibirica*, Altai, Mongolia, July, coll. *Murashkinsky*, comm. as *S. Karstenii* Bres.; on living aged trunk of *Chamaeocyparis formosensis*, altitude 6000–8000 ft., Formosa, Japan, comm. by D. Numata, Kyoto Imperial Univ.

Stereum versiforme Berk. & Curtis

On *Quercus mongolica* and *Rhododendron* sp., District Amur, Eastern Asia, August to October, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 083, B 087, and B 0131 respectively.

Hymenochaete badio-ferruginea (Mont.) Lév.

On *Larix dahurica*, District Amur, Eastern Asia, August, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 0101.

Hymenochaete Mougeotii (Fr.) Cooke

On *Rhododendron dahurica*, District Sajany, Siberia, July, coll. *Murashkinsky;* on *Abies sibirica*, District Tara, October, coll. *Sheludjakova*, comm. by K. E. Murashkinsky.

***Hymenochaete tabacina** (Sow.) Lév.

On *Prunus Padus*, District Tara, Siberia, October, coll. *Baranov*, comm. by K. E. Murashkinsky.

Corticium confluens Fr.

On *Quercus mongolica*, District Amur, Eastern Asia, October, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 092.

Corticium frustulosum Bres.

On *Pinus silvestris*, District Tara, Siberia, August, coll. *Murashkinsky*, B 03.

Corticium galactinum Fr.

On *Quercus mongolica*, District Amur, Eastern Asia, September, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 0103.

In Mo. Bot. Gard. Ann. 13: 202. 1926, I reported specimens of

this species from Japan, Prov. Awaji, collected by Yasuda at Hiroto-Mura and Mt. Mikuma.

Corticium hydnans (Schw.) Burt

Corticium colliculosum Berk. & Curtis; *C. Queletii* Bres.

On *Salix* sp., District Barnaoul, Siberia, June, coll. *Konjev*, comm. by K. E. Murashkinsky, B 025.

Corticium illaqueatum Bourd. & Galz.

On charred wood of *Populus tremula*, District Barnaoul, Siberia, May, coll. *Konjev*, comm. by K. E. Murashkinsky, B 029.

Corticium investiens (Schw.) Bres.

On *Pinus silvestris*, District Tara, Siberia, September, coll. *Murashkinsky*, B 012.

Corticium lactescens Berk.

On *Salix* sp., District Omsk, Siberia, September, coll. *Murashkinsky*.

Corticium laeve Pers.

On *Abies sibirica*, District Wjatka, April, coll. *Fokia*, comm. by K. E. Murashkinsky.

Corticium ochraceum Fr.

On *Sorbus Aucuparia*, District Sajany, Siberia, July, coll. *Ziling*, comm. by K. E. Murashkinsky.

Corticium polygonium Pers.

On fallen twig of *Populus* sp., District Sajany, Siberia, July, coll. *Murashkinsky*.

Corticium radiosum Fr.

On *Pinus silvestris*, District Tara, Siberia, August, coll. *Murashkinsky*.

Corticium roseum Pers.

On *Salix* sp., District Tara, Siberia, June, coll. *Murashkinsky*.

Corticium sulphureum Fr.

Young, sterile mycelial stage on *Philadelphus* sp., Promorje, District Vladivostok, Eastern Asia, July, coll. *Ziling*, comm. by K. E. Murashkinsky, B 035.

Peniophora corticalis (Bull.) Bres. (= *Peniophora quercina* (Pers.) Cooke).

On *Quercus mongolica*, District Amur, Eastern Asia, November, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 091.

Peniophora gigantea (Fr.) Massee

On *Pinus silvestris*, District Tara, Siberia, August, coll. *Murashkinsky*.

Peniophora mutata (Peck) Bres.

On *Populus tremula*, District Sajany, Siberia, July, coll. *Murashkinsky;* on *Populus tremula*, District Tara, Siberia, coll. *Poljakov*, comm. by K. E. Murashkinsky.

Coniophora byssoidea (Pers.) Fr.

On wood of *Pinus silvestris*, District Barnaoul, Siberia, June, coll. *Konjev*, comm. by K. E. Murashkinsky, B 028.

Coniophora olivacea (Fr.) Karst.

On charred wood of *Pinus silvestris*, District Barnaoul, Siberia, May, coll. *Konjev*, comm. by K. E. Murashkinsky, B 030.

Coniophora sibirica Burt, n. sp.

Type: in Burt Herb.

Fructification effused, membranaceous, separable when moistened, fibrous, drying raw umber of Ridgway, the margin thinning out, concolorous; hymenium even, pulverulent, not setulose; structure in section 200–250 μ thick, composed of loosely interwoven, rigid, even-walled, non-incrusted, dark-colored hyphae 4–5 μ in diameter, which give their color to the fructification and are not nodose-septate; no cystidia; spores colored, even, 11 × 6 μ.

On decaying coniferous wood, probably *Pinus silvestris*, District Tara, Siberia, August, 1921, coll. *Murashkinsky*, comm. as *C. atrocinerea*.

Coniophora sibirica is related to *C. arida* but is distinct by coarser, thicker-walled, and more rigid hyphae and fructifications which may be peeled away from the substratum when moistened.

Aleurodiscus disciformis (DC.) Pat.

On bark of *Acer* sp., Primorje, District Vladivostok, Eastern Asia, June, coll. *Ziling*, comm. by K. E. Murashkinsky, B 033.

***Aleurodiscus diffissus** (Sacc.) Burt, n. comb.

Peniophora diffissa Sacc. Soc. Roy. Bot. Belg. Bul. **28**: 79. *pl. 4. f. 2.* 1889; Syll. Fung. **9**: 239. 1891.

Fructifications gregarious, crowded, somewhat disk-shaped, tuberculiform, wood-brown of Ridgway, cracking to the substratum and splitting into small fructifications, coriaceous, centrally attached, the margin free, darker underneath; hymenium wood-brown, coarsely wrinkled, not shining; in section 500 μ thick, army-brown, composed of suberect, interwoven, colored hyphae about 2 μ in diameter, with a darker zone along the substratum; bottle-brush paraphyses (dendrophyses) with deeply staining body about 4 μ in diameter, and numerous slender lateral branches about 4 μ long are intermixed with other infrequent paraphyses having somewhat moniliform tips; spores hyaline, even, globose, 5½–6 μ in diameter.

On bark of decaying *Rhododendron dahuricum*, District Sajany, Siberia, July 11, 1927, coll. *Murashkinsky*.

Aleurodiscus diffissus resembles somewhat in aspect *Stereum rufum* and *Corticium polygonium*. The small fructifications 1–2 mm. in diameter and 500 μ thick are densely gregarious over areas up to 5 cm. long by 2 cm. wide and show well the character of forming new fructifications by splitting, as shown by Saccardo in his fig. 2b and upon which he based the specific name. The hymenial bottle-brush and moniliform paraphyses are like those of *A. cerrusatus*.

Cytidia salicina (Fr.) Burt

On *Salix* sp., District Tara, Siberia, September, coll. *Ziling*, comm. by K. E. Murashkinsky.

Microstroma Juglandis Sacc.

On living leaves of *Juglans regia*, Russia, July, comm. by K. E. Murashkinsky.

This species is included by some authors in the Basidiomycetes.

CLAVARIACEAE

Clavaria formosa (Pers.) Fr.

On the ground, District Amur, Eastern Asia, August, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 088.

DACRYOMYCETACEAE

Ditiola conformis Karst.

On rotting coniferous wood, District Tara, Siberia, October, coll. *Baranov*, comm. by K. E. Murashkinsky.

Femsjonia luteo-alba Fr.

On *Pinus silvestris*, District Barnaoul, Siberia, August, coll. *Konjev*, comm. by K. E. Murashkinsky, B 019.

TREMELLACEAE

***Exidia glandulosa** (Bull.) Fr.

On *Betula verrucosa*, District Omsk, Siberia, August, coll. *Murashkinsky*.

Eichleriella spinulosa (Berk. & Curtis) Burt

On *Populus nigra*, District Sajany, Siberia, coll. *Katajewskaja*, comm. by K. E. Murashkinsky.

Sebacina calcea (Pers.) Bres.

On *Larix sibirica*, District Sajany, Siberia, July, coll. *Murashkinsky*.

AURICULARIACEAE

Auricularia auricula-Judae (L.) Schroet.

On *Ulmus* sp., Prov. Primorsk, Eastern Asia, July, coll. *Avotia*, comm. by K. E. Murashkinsky, B 45.

Auricularia auriformis (Schw.) Earle

On *Quercus mongolica*, District Amur, Eastern Asia, October, coll. *Krawtzew*, comm. by K. E. Murashkinsky, B 095.

The specimen, somewhat shattered in transit, is dark mouse-gray and somewhat olivaceous where hairs are best developed, 2½ cm. broad, very thin, 1260 μ in section, with hairs of the upper surface 40–60 μ long, not at all bulbous at base; spores 9–16 × 4–5μ. The specimen agrees well with gatherings from South Carolina in my herbarium which I compared with an authentic specimen from Herb. Schweinitz.

Septobasidium Carestianum Bres.

On *Ribes* sp., District Sajany, Siberia, July, coll. *Murashkinsky*.